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CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

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DOUBLE COMPOUNDING.

An interesting development in the design of direct-current dynamos which is met occasionally is the use of two series windings, which may, for the moment, be designated as double compounding. The function of one of these windings is to provide a commutating field, and the other to increase the voltage of the machine as the load increases, and thus to overcompound the dynamo.

The use of a series winding placed on the same poles as the main magnetizing coil is almost universal in dynamo construction, and is practised, to some extent, in motor design for special purposes. With respect to the former use, the function of the coil is to counteract the armature reaction, and, if desired, to increase, in addition, the magnetization of the field, thus causing the voltage of the generator to increase with an increase in the load—the practice usually designated as overcompounding. The idea of employing a series winding merely to overcome armature reaction is not new, and when proposed for this purpose it has been thought that with a coil placed in such a direction as to have the opposing field directly opposite to the field set up by the armature that some advantage might be gained; and from this idea arose the early attempts to improve the performance of a generator by the use of auxiliary poles placed generally midway between the main poles; or of an auxiliary series winding placed around the armature so as to set up a magnetic field more nearly opposed in direction to the armature field. The chief advantage to be gained from such an arrangement was the improved commutation which could be secured; for if it were desired merely to maintain a constant total flux through the armature, a coil placed around the main poles would be just as effective. But such a coil would not be as effective as the auxiliary pole in preventing a rotation of the neutral plane, and therefore in preventing a shifting of the plane of commutation with the load.

These early attempts to improve commutation were abandoned, not because they were not effective, but because they became unnecessary, due to improved design. Recently, however, new conditions have arisen in which it seems that an auxiliary commutating field becomes desirable. These conditions have been brought about through the demand for high-speed generators such as are to be driven by steam turbines, and for variable-speed motors. The object of the auxiliary winding is mainly to provide a commutating field fixed in direction, but varying in strength so as to produce the proper conditions for all loads. Such a coil, by acting against the armature reaction, has the effect of a compound winding, and it may be made to balance this; but if a perfect balance be

obtained, the generator will not be perfectly compounded because of the drop of potential due to the armature resistance. If the auxiliary pole be made stronger, so as to produce a perfect compounding, or if the effect be carried further and overcompounding be sought, the same conditions will be set up at the commutator, though in a less degree, as were sought to be overcome by the introduction of the auxiliary pole—that is to say, the commutating field will not be directly under the auxiliary pole, but a little to one side, and its position will vary with the degree of compounding. Although the auxiliary pole is employed to maintain a fixed commutating plane, the use of the series winding on this pole for regulation purposes partially defeats the object sought. This difficulty may be got over by placing on the main field a series coil which provides the necessary increase in field strength to give the desired overcompounding. But this plan really gives us a dynamo with three field-windings—one more than we have been accustomed to. They are the main shunt-winding for providing the initial excitation, the main compound winding for producing the necessary variation in this excitation to give the degree of regulation sought for, and the auxiliary compound winding, the function of which is merely to provide a commutating field. This, in a sense, analyses the field-winding as we are accustomed to analyze the armature reaction. Part of the effect is applied in the direction of the main field, and part in quadrature with this. But it should be remembered that this comparison is not exact, for the main series field does not merely balance the demagnetizing effect of the armature, but actually increases the total strength of the field. And the auxiliary winding, also, does not merely balance the cross-magnetizing effect of the armature, but it must do more: it must supply a commutating field.

ELECTRIC RAILWAY DEVELOPMENT.

It has perhaps been inevitable with such rapid growth going on in the electric railway field that, in some places, the work would seem to have been done not wisely, but too well. A few years ago the financial success which had resulted from the electrification of street railway systems gave rise to an extension of these lines into thinly settled districts and to the building of purely country lines; and from these growths there came the true interurban line connecting two important commercial centres. In some sections this building went on apparently when there was no need for the transportation facilities being constructed. Conditions of late have bettered considerably, and there is not now the same feverish haste to secure franchises and build some sort of a line. But, in a good many instances, the builders, taking warning from the experiences of the early roads, have gone rather to the other extreme and, while seeking to construct a profitable line, have invested more money in the road than the opportunities for securing traffic warrant. The earlier builders erred by neglecting the engineering side of railway building, and were content to spike down two lines of rails on ties laid alongside a country road. Grades, road crossings and other obstructions had no terrors for them. What they were seeking to do was to start the cars moving and then sell out. Now, one not infrequently finds an interurban line which for many years can not be expected to carry a heavy traffic laid out and constructed as though it were to be a trunk line. Skilled engineers are secured for building the road, and they seem to let their wishes run away with their judgment, and build as though the road were going to carry all the freight and passengers of a large district. While the earlier roads put a constant drain upon the operating company for maintenance, and perhaps entire reconstruction, the newer method may cause an even greater loss on account of the heavy expense for permanent way and equipment. Although maintenance and repairs may be slight, interest must be paid on the investment, and it is better to have a less imposing line reaching to the point sought than to have a magnificent sample of engineering work going only half way there. The older roads were built to sell. For this reason many did not become profitable when operated. The newer type of road is built to run, and often is not profitable because the profit-making feature has not been studied sufficiently by the builders.

The design of every new road should result from a careful examination of the best type of construction to be adopted and of the probable revenue to be obtained. While every one will admire a beautifully constructed road and handsome cars, every unnecessary dollar expended for these causes a direct loss in interest to the investors. There is no necessity to use a 100-pound rail for a country trolley road, nor are double-truck cars required to handle light country traffic. The conditions in each case must be weighed carefully and the cheapest construction which will give satisfactory service should be adopted in the first case. After that no improvement should be made except such as can be shown to be profitable, either because of the better service or safety, or for other good reasons. The engineer in charge of the construction should not let his desire to build a beautiful road run away with his good judgment, but, on the other hand, he should insist that the builders of the road decide upon a type of construction that will do the work. A straight, heavy-ballasted, double-track road is a pretty thing, but its value is much diminished if it only goes half the way to the place for which it started. On the other hand, a line connecting two cities, which is built so poorly that the cars can not get over it, will not draw the traffic that is sought. There are two of the leading cities of this country, only about forty miles apart, which for years past have been promised an interurban electric line. For various reasons this road has yet to be built. The two cities are already well served by steam roads, and the traffic that would be picked up along the way would be of little importance. The only advantage an electric system would have over the steam roads, besides the greater comfort of traveling in an electric car, would be in transferring from the interurban line to the local lines at the two cities, and perhaps in offering a more frequent service. It is a question whether such a road would offer a service more frequent than that now existing, and as, at present, passengers are deposited at convenient points, the transfer feature of the electric line would

not be of much importance, particularly if it were necessary for the passenger to change cars, which he probably would have to do if high-speed cars were run over the electric line, as would have to be the case if this road wished to enter into competition with the steam service. Here is an instance which, at first sight, would seem to offer an excellent opportunity for constructing a high-speed interurban line; yet the fact that this has not been accomplished up to the present time, although it has been promised again and again, shows that, for some reason or other, capital has been rather doubtful about the wisdom of the plan.

In another branch of electric railway development the public seems to be looking for greater changes than the engineers at present expect to take place. Because it sees great work going on at certain points, it seems to think that this is merely the first step in the general conversion from steam to electric power. Such a conversion is, nevertheless, a long way off, and except where special conditions call for special methods, we must be content to let the steam locomotive do the work for which it is best suited. It is contended by some that great advantages will result from the use of the electric locomotive. One of these advantages, it is said, will be a large increase in the traffic-carrying capacity of the road. Such a gain would be of great importance, if it could be made without too great a sacrifice; but it yet remains to be demonstrated in practice how great the gain would be. It figures out very nicely on paper, but what we need is something of a more practical character. In the meantime the electric railway engineer should devote his energies to improving his systems, and thus render them more reliable and less expensive, and in this way bring nearer the hoped-for change.

INCREASING THE STANDARDS OF ILLUMINATION.

It has been noted again and again in the technical journals, and probably every one has observed it for himself, that the standard of illumination in nearly all buildings, both public and private, has been increasing. Where before we were satisfied with a few dim gas jets giving just enough light to avoid chairs and other obstructions, we now demand not merely that the room shall be comfortably lighted, but that it must be brilliantly lighted. The same applies, though in a less degree, to street lighting, but there is not the same objection here, since it is seldom that a street, taken as a whole, is too brilliantly lighted.

The standard has undoubtedly been set by public buildings, and has followed the introduction of electric lights; and while beautiful effects have been sought, those in charge seem to believe that the brighter the lighting the better, and nothing less than a brilliant show would be satisfactory. Hotels, theatres and public halls of all kinds must be so bright that any one can read small print, no matter where he stands. This practice, as has been pointed out, has undoubtedly influenced the lighting of private houses, for any one going from a brilliantly lighted public dining room to his own can not but feel the contrast, and thinks that his own is gloomy and dark, and that he must have as much light in every part of his room as he found in the public room. If he can not correct what he thinks to be the fault by turning on several more lamps, lamps of larger candle-power are substituted; and this man's method is apt to influence his neighbors. Where formerly we were satisfied to take a seat near a lamp to get sufficient light for reading, and to have the room otherwise comfortably, but not brilliantly lighted, we now think that we must be able to read in any part of the room and sit in any position.

This toning up of our standards of illumination not only is leading to an increase in the number of lamps lighted at a time, but has led to the suggestion that our standard sixteen-candle-power lamp is perhaps out of date, and that a lamp having a higher rating should be accepted. It would be well, however, to consider any such step carefully before undertaking it. Our present standard is about double that of Europe, where the eight-candle-power lamp is the one mostly used. This change from sixteen to twenty or more would, it is true, bring the ordinary incandescent lamp more nearly to the same candle-power as the standard incandescent gas lamp, but it does not seem wise to take a false step for such a slight gain. It is a matter of opinion with many that we have already gone very much too far. It would be better for us if we were satisfied with less brilliant lighting of a few rooms, but with a more uniform distribution of light throughout the house. To change from our present standard lamp to one higher would make the problem of securing the best lighting of a room still more difficult, as lamps of large candle-power or high intrinsic brilliancy are not only dazzling, but by their effect upon the retina may actually make it more difficult to see. Smaller units would not only assist in preventing a dazzling effect, but might even make reading and other similar occupations easier, even though the intensity of illumination be less.

The trend towards units of larger candle-power may be attributed not only to the general drifting toward brighter lighting, but to the fact that the newer forms of incandescent lamp are more easily made in the larger sizes; and there is not wanting a feeling on the part of the lighting companies that the more efficient lamps may cut down their sale of current. The latter idea will probably be discovered to be unfounded, for the introduction of the Welsbach burner has really increased the consumption of gas, an indication that the more efficient forms of electric lamp will probably increase the consumption of current. But this increase should come through an increase in the number of lamps used, not through an increase in the candle-power of the standard lamp.

The tendency to use more and more light is not in itself wrong. It is merely the application that is wrong. What we need is a more intelligent use of our sources of light. There should be less contrast between the brilliantly lighted parlor and the dark hall, the dazzling dining room and the gloomy kitchen. What is needed is education of the public in the proper use of lamps, for taste in this matter seems to-day about as crude as it can well be. It is gratifying that with this condition confronting us that that young body, the Illuminating Engineering Society, should be doing such excellent work. The work of this society during the past season was most successful, and at the initial meeting this fall two interesting and valuable papers were presented, one dealing with the subject in question—that is to say, the lighting of buildings.

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

VI—The Approximate Analysis of Feed-Waters.

The details given in the previous article relating to the sources of natural water supply prove that all natural waters contain variable amounts of suspended or

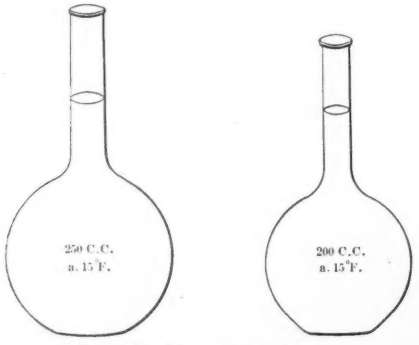

Fig. 23.—Measuring Flasks.

dissolved impurity, and that in some cases these impurities may be present in very considerable quantity.

For the purposes of the boiler engineer it is of importance to know the total amount and the general characteristics of these impurities, although the exact determination of each individual chemical compound may be unnecessary. An approximate analysis of the feed-water will supply the information required, since this may be carried out so as to yield the (1) alkalinity or acidity; (2) total suspended solids; (3) total dissolved solids; (4) temporary hardness; (5) permanent hardness; (6) oils and fats, without the separate determination of the various salts that give the water these characteristics. An approximate analysis of a feed-water, with strict attention to all the details of manipulation named below, may be carried out by an engineer, after some little practice with the apparatus and methods described. A complete chemical examination, on the other hand, can only be carried out by a chemist skilled in water analysis; and no attempt is made in this article to deal with the methods by which the calcium and magnesium salts in water are separately determined. The engineer who attempts the approximate analysis of water is, however, advised to practice with samples of water that have been submitted to independent tests by a competent expert, before venturing to place much dependence upon his own results, since owing to the use of volumetric methods the work is more difficult than the approximate analysis of fuels.

(1) Alkalinity or Acidity — Most natural waters are slightly alkaline owing to the presence of dissolved carbonates of the alkaline earth metals. Such waters color neutral litmus paper a slightly blue tint, and give a pronounced canary-yellow tint to methyl orange, the indicator usually employed for this work. In order to estimate the total alkalinity of the water, 200 cubic centimetres of the sample taken as described in Article V, filtered if suspended matter be present, are measured in the flask shown in Fig. 23. These 200 cubic centimetres are then emptied into a white porcelain basin of about twenty-two ounces capacity. The flask is rinsed out

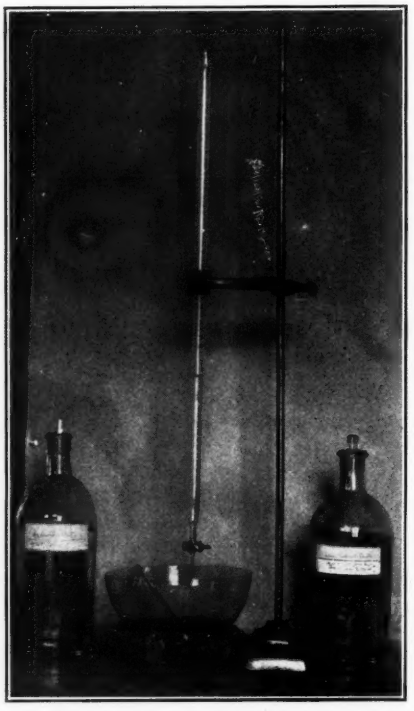

Fig. 24.—Water Testing Apparatus.

with distilled water, the washings are added to the liquid in the basin, and two drops of a concentrated solution of methyl orange are also added to the water. A standardized solution of hydrochloric acid of one-fifth normal strength[1] is now added from a burette drop by drop with constant stirring until the color of the liquid in the basin changes from canary yellow to orange and finally to faint pink, this last change being taken as the end point of the reaction.

The number of cubic centimetres of the hydrochloric acid solution used from the burette are then read off, and the result is calculated as parts of calcium carbonate per 100,000 of water.

In the case of water from peaty lands it will often be found that these give a slightly acid reaction, due to the decomposition of the organic matter of the peat, but that these organic acids are not revealed either by litmus paper, or by methyl orange. Such waters in fact appear to be alkaline with the last-named indicator. It is necessary in the case of these waters, therefore, to use an alcoholic solution of phenol-phthalein as indicator, and to heat the 200 cubic centimetres of water after filtration and measuring, in the porcelain basin, before titrating with the standard alkali solution—carbonate of soda.

Phenol-phthalein is colorless with acids, but yields a purple-red tint with the slightest excess of alkali, and the standard solution of alkali is, therefore, dropped in from the burette with constant stirring of the liquid in the basin, until a permanent purple-red color is obtained. The number of cubic centimetres of the standard alkali solution used is then read off, and from this the result is calculated—not as acid, but as the alkali equivalent of the acid present in the water.

Fig. 24 shows the apparatus used for making these tests. The burette holds fifty cubic centimetres, each cubic centi-

Fig. 25.—One-Litre Measuring Flask.

metre divided in tenths, and is provided with a glass stop-cock. The standard solutions of acid and alkali employed are contained in the glass bottles shown on either side of the burette and titration basin.

The solutions of acid and alkali are made as follows:

Twenty-one and one-half grammes of pure anhydrous carbonate of soda are

[1] A normal solution contains the molecular weight of the chemical in grammes in 1,000 cubic centimetres of water.

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weighed out, and dissolved with the aid of heat in 250 cubic centimetres of distilled water. This solution is then made up to nearly 1,000 cubic centimetres in the large measuring flask shown in Fig. 25 and is cooled to fifteen degrees centigrade before finally diluting to the mark on the neck, and transferring to the stoppered glass bottle shown on the right in Fig. 24.

This solution is labeled "Standard Alkali 1-5 N.," the exact strength being placed on the label afterward, when the solution has been titrated with the 1-5 N. acid solution.

The latter is made by taking forty cubic centimetres of pure concentrated hydrochloric acid and diluting this to 1,000 cubic centimetres after cooling to fifteen degrees centigrade.

This solution is now transferred to the other storage bottle shown in Fig. 24 and is labeled "Standard Acid 1-5 N." It is checked by weighing out very carefully 0.40 gramme of the pure carbonate of soda (after drying one-half hour in the platinum crucible at a low red heat), dissolving this in the porcelain basin, in a small quantity of hot water, diluting with a large volume of cold water and

FIG. 26.—TWENTY-FIVE CUBIC CENTIMETER PIPETTE.

titrating with the standard acid solution, using methyl orange as indicator. The change from canary yellow to faint pink—with orange as an intermediate stage—indicates the end of the reaction. It will be found that about twenty cubic centimetres of the standard acid solution are required to neutralize the 0.40 gramme of sodium carbonate—and the test is repeated for the sake of accuracy. Finally the standard alkali solution is itself checked, by measuring off twenty-five cubic centimetres in the pipette shown in Fig. 26 and by titrating this with the normal acid as before.

The following are examples of this method of checking the standard solutions:

1. $\frac{n}{5}$ HCl solution, 0.40 gramme Na_2CO_3 used for each test.[1]

No. 1 required 19.8 cubic centimetres.....	mean 19.85 cubic centimetres.
No. 2 required 19.9 cubic centimetres.....	

It was calculated from this that 100 cubic centimetres of the $\frac{n}{5}$ acid solution equaled 2.015 grammes Na_2CO_3 or 1.900 grammes $CaCo_3$, and these figures were placed upon the label below the description.

2. $\frac{n}{5}$ Na_2CO_3 solution, 25 cubic centimetres used for each test.

No. 1 required 24.0 cu. centimetres HCl solution.
No. 2 " 24.1 " " "

Mean.....24.05 cu. centimetres HCl solution.

From this it was calculated that 100 cubic centimetres of the $\frac{n}{5}$ alkali solution equaled 96.2 cubic centimetres of the $\frac{n}{5}$ acid solution, or 1.937 grammes Na_2CO_3, or 1.827 grammes $CaCO_3$.

These values were, therefore, placed upon the label of the standard alkali solution.

In testing waters the basin and burette must be well washed and rinsed with distilled water before each test, and the burette must also be rinsed with the stand-

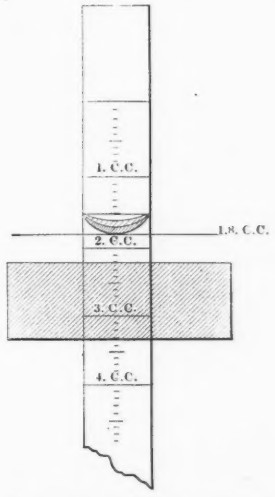


FIG. 27.—MENISCUS OF SOLUTION IN BURETTE.

ard test solution before it is filled for the actual titration. The level of the solution is best read off by holding a black strip of paper one-quarter of an inch below the meniscus, and by reading from the lower curve of this, as shown in Fig. 27.

The following is an example of the calculation for water showing alkalinity:

Water used, 200 cubic centimetres.

Standard acid solution required to neutralize it 3.70 cubic centimetres.

$\frac{3.7 \times 100{,}000 \times 0.019^1}{200} = 35.15$ parts calcium carbonate per 100,000 of water.

An acid water from peaty land gave the following results:

Water used, 200 cubic centimetres.

Standard alkali solution required to neutralize it 1.10 cubic centimetres.

$\frac{1.1 \times 100{,}000 \times 0.01937}{200} = 10.653$ parts sodium carbonate per 100,000 of water.

(2) Suspended Solid Matter—Water from rivers and surface drainage generally is often charged with suspended matter, and it is at times necessary to determine the amount of this. A four-inch circle of specially prepared filter paper is folded in radiating rib fashion to promote quick filtrations, and is dried in the stoppered drying tube for one hour at 230 degrees Fahrenheit. Fig. 4 in Part I shows the air bath used; and Fig. 28 shows the tube employed for drying filters, the stopper being, of course, removed during the application of heat. The tube and filter are placed in the desiccator and are weighed together when cold, the stopper being inserted in the tube to prevent absorption of moisture by the filter while being weighed. The filter paper is now removed with small forceps from the tube, is placed in a funnel of suitable size with the least possible handling or rubbing of the folds; and 200 cubic centimetres of the water are measured and poured through it. The large sample of water must be well shaken

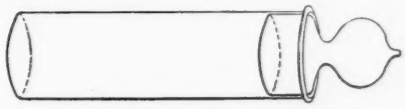


FIG. 28.—FILTER DRYING TUBE.

before withdrawing 200 cubic centimetres for this test. The filter with its contents is finally washed with cold distilled water, dried in the funnel as far as possible by suction, and is then removed carefully from the funnel and placed in the drying tube, for the final heating at 230 degrees Fahrenheit. The drying must be continued until a constant weight is obtained. The gain in weight multiplied by 500 gives the pints of suspended matter per 100,000 of water.

The following is an example of the figures obtained in this test:

Drying tube and filter and residue.....	12.122 grammes
Drying tube and filter alone...	12.067 "
Gain in weight...	0.055 gramme

$0.055 \times 500 = 27.50$ parts of solid suspended matter per 100,000 of water.

The color of the dried residue upon the filter paper will give some indication of its composition; iron oxides being generally red, and clay or alumina compounds being slaty gray in color.

(3) Total Solids—If the suspended matter has been separately determined by the method just described, the filtered sample of water is used for this test. Should the suspended matter not have been separately determined, the unfiltered

[1] The chemical symbol for hydrochloric acid is HCl, for carbonate of soda Na_2CO_3, and for carbonate of lime $CaCO_3$.

[1] The factor 9.5 can be used in these calculations in place of $\frac{100{,}000 \times 0.019}{200}$.

water, well shaken, is employed for the total solids determination. This is carried out by evaporating 250 cubic centimetres of the water to dryness, in a tared platinum basin. Fig. 29 shows the apparatus used for this test. The basin is 2.4 inches in diameter and holds fifty cubic centimetres of water. The water bath is of copper, six and one-half inches in diameter, holds 1,000 cubic centimetres, is provided with rings of various sizes, and is supported upon a piece of iron gauze resting on a large tripod stand.

A bamboo or glass triangle with a long leg fitted into a cork which slides upon the upright of a retort stand is employed as shown in Fig. 29 to carry a piece of glazed paper, in order to protect the water in the platinum basin from dust or dirt. A large cork on the upper side of this dirt-shield serves to hold it in its place. The platinum basin must not be allowed to touch the copper ring of the water bath, but must be supported by three squares of filter paper, folded to form thick wedges and inserted between the basin and the edge of the ring, in such a way that an annular space is left for the escape of the steam from the water in the bath. The platinum basin must be thoroughly cleaned and dried by heating for five minutes in the air bath at 230 degrees Fahrenheit, before weighing. About forty cubic centimetres of the sample water measured in the 250-cubic-centimetre flask shown in Fig. 23 are then poured carefully into the basin already placed in position on the ring of the water bath with the aid of the filter-paper strips already referred to, and the evaporation is commenced.

It is advisable never to fill the basin within one-quarter of an inch of the rim, since many salt solutions have a tendency to creep up and over the sides when being evaporated to dryness. It is also advisable to keep the water bath in steady but not violent ebulition, by regulation of the gas flame beneath it. As the evaporation proceeds, the remainder of the 250 cubic centimetres are gradually added, and finally the 250-cubic-centimetre flask is rinsed out with distilled water and the washings added to the liquid in the basin. The platinum basin is kept upon the water bath until the residue of salts is apparently quite dry. It is then removed, the bottom of the basin is carefully cleaned and wiped dry, any deposit being removed by aid of HCl and a wet towel, and the basin and its contents are heated three hours at 300 degrees Fahrenheit in the air bath. The desiccator must be employed during the last stage of cooling before weighing; as perfectly dry salts are always hygroscopic. The increase in weight of the basin multiplied by 400 gives the parts of solid matter per 100,000 of water.

The following is an example of the figures obtained in the test:

Platinum basin and residue from 250 cubic centimetres of unfiltered water.....	26.165 grammes
Platinum basin alone.....	26.023 "
Weight of residue.....	0.142 gramme

$$\frac{0.142 \times 100.000}{250} = 56.8 \text{ parts of solid matter for 100,000 of water.}$$

Should it be desired to find what proportion of this residue is present as organic matter, the basin and its contents are heated to redness for five minutes upon a platinum-wire support over a large Bunsen burner, the change in color being noticed during this further heating. Organic compounds darken and char

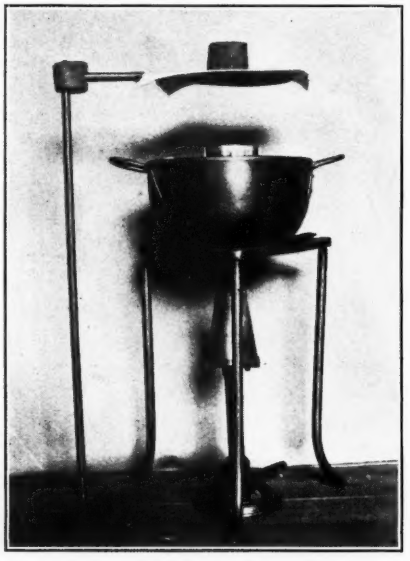


FIG. 29.—PLATINUM BASIN AND WATER BATH.

under this treatment. The basin is then allowed to cool, the residue is moistened with a solution of ammonium carbonate in water to reconvert the oxides into carbonates, and the excess of ammonium carbonate and water is then driven off by application of gentle heat. Care must be taken during this operation that the basin and its contents do not approach a red-heat, otherwise the calcium and magnesium carbonates will be again reconverted into oxides. Finally the basin is cooled in the desiccator and again weighed. The loss in weight by this treatment, multiplied by 400, gives the parts of organic matter per 100,000 of water.

The following is an example of the figures obtained in this test:

Basin and residue after drying at 300 degrees Fahrenheit.....	26.142
Basin and residue after ignition and treatment with ammonia carbonate...	26.120
Loss by ignition.....	0.022

$$\frac{0.022 \times 100,000}{250} = 8.80 \text{ parts of organic matter per 100,000 of water.}$$

(4 and 5) Temporary and Permanent Hardness—The temporary hardness of water is caused by the presence of carbonates of lime and magnesia in solution; permanent hardness is due to the corresponding sulphates and oxides of these two elements. The Clark test for hardness is carried out by shaking the water before and after boiling with a standard soap solution, and by measuring the volume of this required to produce a permanent lather. The Clark or English degree of hardness represents the grains of calcium carbonate in one gallon of water;[1] while the French degree of hardness represents the parts of calcium carbonate in 100,000 parts of water, and the German degree of hardness represents the parts of calcium oxide (CaO) in 100,000 parts of water. The Clark test for hardness is not very satisfactory, although still generally employed in this country. The results obtained vary within wide limits, and are much too dependent upon the personality of the tester. For this reason the Clark test with soap solution is now giving place to the more scientific ones described below, in which the weight of calcium and magnesium carbonates and of calcium and magnesium sulphates, as determined by the approximate analysis, are used for calculating the degrees of hardness of the water.

The alkalinity test already described yields the English degrees of hardness, if the parts of calcium carbonate per 100,000 of water as ascertained by the cubic centimetre of standard acid solution used be multiplied by 0.7.

The following is an example of the figures obtained in this test:

Two hundred cubic centimetres of filtered water took 3.7 cubic centimetres of standard acid solution, using methyl orange as indicator.

$$\frac{3.7 \times 0.019 \times 70.000}{200} = 24.61 \text{ English degrees of hardness.}$$

The expression $\frac{0.019 \times 70,000}{200}$ can be reduced to the factor 6.65 to simplify the calculation for temporary hardness. The cubic centimetre of standard acid solution

[1] This figure was chosen by Clark because in his day the gallon was the standard of volume. There are 70,000 grains in one gallon.

used, multiplied by 6.65, then gives the temporary hardness in English degrees.

The permanent hardness of water can be approximately ascertained by aid of the results obtained in the tests for total solids, if the filtered water has been used for carrying out this test, and no organic matter be present to complicate the calculation.

The results of this test expressed in parts per 100,000, and multiplied by 0.7, will then give the total hardness in English degrees, and the difference between the total hardness and the temporary hardness yields the permanent hardness. Taking the figures given in Sections 1 and 3 of this article as an example, we have:

Total solids, 56.8 per 100,000 of water. $56.8 \times 0.7 = 39.7$ parts $CaCO_3$ per 70,000 of water, or total hardness in English degrees.

FIG. 30.—SEPARATING FUNNEL.

The temporary hardness of this water as found by test 1 was, however, 24.61 degrees, and 39.76 less 24.61 gives 15.15 as the permanent hardness, expressed in English degrees.

It is safer, however, to make a special test for the sulphates and oxides which produce permanent hardness. This is carried out as follows:

One hundred cubic centimetres of the filtered sample of water are taken and evaporated to dryness on the water bath in the platinum basin with an addition of twenty-five cubic centimetres of the standard sodium carbonate solution. This treatment decomposes the sulphates and oxides, and converts them into carbonates. The residue is dissolved in distilled water and is gently heated. The carbonates of lime and magnesia present in the residue are left insoluble, and are now removed by filtration. The filter and its contents are well washed with warm water to remove the excess of alkali. The filtrate and washings are collected in the porcelain basin shown in Fig. 24, and after cooling are titrated with the standard acid solution, using methyl orange as indicator. The amount of acid solution required to neutralize the carbonate of soda remaining in the filtrate enables one to calculate how much has been used for decomposing the sulphates and oxides.

The following is an example of the figures obtained in this test:

One hundred cubic centimetres of the filtered water were evaporated with twenty-five cubic centimetres of standard alkali solution.

The filtrate and washings required 22.5 cubic centimetres of standard acid solution to neutralize the excess of alkali.

Now, as 100 cubic centimetres of the alkali solution are equivalent to 96.2 cubic centimetres of the acid solution, 25 cubic centimetres equal $\frac{96.2}{4}$: 24.05 cubic centimetres, and $24.05 - 22.50 = 1.55$ cubic centimetres. This is the volume of acid corresponding to the carbonate of soda which has disappeared in this test.

The calculation for the permanent hardness is therefore as follows:

$$\frac{1.55 \times 0.019 \times 70.000}{100} = 20.60 \text{ parts}$$

$CaCO_3$ per 70,000 of water.

The expression $\frac{0.019 \times 70.000}{100}$ can be reduced to the factor 13.3 to simplify calculation. The cubic centimetre used, multiplied by 13.3, then yields the permanent hardness in English degrees.

It is possible to make the standard solutions of acid and alkali of such a strength that the degrees of hardness can be read off directly from the cubic centimetre of solutions used in making the test.

It is, however, somewhat troublesome to make a solution of hydrochloric acid, 100 cubic centimetres of which shall equal exactly 0.143 gramme of $CaCO_3$, and another of carbonate of soda, one cubic centimetre of which shall exactly neutralize one cubic centimetre of the standard acid solution. Moreover, hydrochloric acid solution is liable to change in strength, when above or below a definite limit of concentration. The writer has therefore thought it best to show how solutions of approximately fifth normal strength may be applied to water-testing without alteration. As already pointed out, by the use of single factors for the fixed values of the calculation, the labor in calculating the temporary and permanent hardness of the water is reduced to a minimum.

In works where many water analyses are made in the course of a day, it will, of course, be found advisable to make the solutions in large quantities and of such a strength that calculation is altogether avoided. In such cases, when using 100 cubic centimetres of water for the hardness tests, the solutions should have the following values:

One hundred cubic centimetres standard acid solution equal 0.143 gramme $CaCO_3$.

One hundred cubic centimetres standard alkali solution equal 100 cubic centimetres standard acid solution.

No simple apparatus can be put into the hands of the fireman or boiler engineer which will enable him to determine for himself the degree of hardness of the feed-water. The use of slips of neutral litmus paper (this is sold in books by chemical-apparatus dealers) will afford some indication of the character and purity of the water supply; but exact chemical tests carried out as described are necessary in order to obtain any information of real value to the boiler engineer.

Special testing sets provided with tabloid chemicals and printed directions which can be read and carried out by any fireman or stoker, are mere inventions of the unscrupulous for the delusion of those engineers who know little of the complex chemistry of the subject.

(6) Tests for Oil—Oil is a most dangerous impurity in boiler feed-water. When using water from condensers for boiler purposes, it is therefore always advisable to test the feed occasionally in order to find if any oily or fatty matter be present.

The sample of water should be cooled before testing, and then shaken vigorously with one-fifth of its volume of petrol or of ether, in the type of separating funnel shown in Fig. 30. The liquid is then allowed to stand fifteen minutes in the funnel supported in an upright position in a retort stand, the water is run off by the separating cock, and the petrol or ether solution which floated on the water and contained all the oil and fat is run into the porcelain basin shown in Fig. 24. This is placed upon the water bath, which is filled with hot water but has no lighted lamp beneath it, since petrol or ether vapor is a most inflammable gas, and all lights must be extinguished in the room where it is present. The petrol or ether evaporates quickly and leaves the oily or fatty matter as a residue in the basin.

If desired, this test can be made quantitative in character by using 250 cubic centimetres of the water for the test, and by transferring the solution of the fat to the tared platinum basin, toward the end of the evaporation. The large porcelain basin and the separating funnel must in this case be rinsed out with the same spirit, and the rinsings added to the solution in the platinum basin.

The oily residue in this, after heating for some time at 212 degrees Fahrenheit, is finally weighed.

To distinguish between animal or vegetable and mineral oils, the residue in the basin should be heated on the water bath with a strong solution of caustic potash. Animal and vegetable oils saponify (*i.e.*, yield a soap) under such treatment, while mineral oils remain unaltered.

The presence of oily and fatty matter in boiling scale can be detected by heating the sample of scale to redness in the platinum basin. If charring occurs, or if a disagreeable odor be noticed, some organic fatty compounds are probably present. Fats and oils of animal or vegetable origin are more dangerous lubricants for engines than hydrocarbon oils of the paraffin class, since the former contain oxygen, and yield organic acids when decomposed at the high temperature occurring in the boiler.

Cooling the New York Subway.

A Description of the New Ventilating System and the Experimental Cooling Plant.

WITHIN the past month the Interborough Rapid Transit Company has placed in operation an extensive system of ventilation at the stations along the subway route operated by the company in New York city. During the heated period of the year, when the temperature on the street was very high, the conditions in the subway became at times entirely unsatisfactory to the engineers and officials of the company, as it was found that while there might be a considerable fall in temperature above ground, the temperature in the subway proper did not follow these changes so as to make the relief appreciable. With a view to improving the ventilation of the subway, the general plan of cutting into the vault lights at a number of the stations and installing ventilating gratings was introduced. To secure further cooling of the atmosphere an experimental cooling plant has been established at the Brooklyn Bridge station of the subway system.

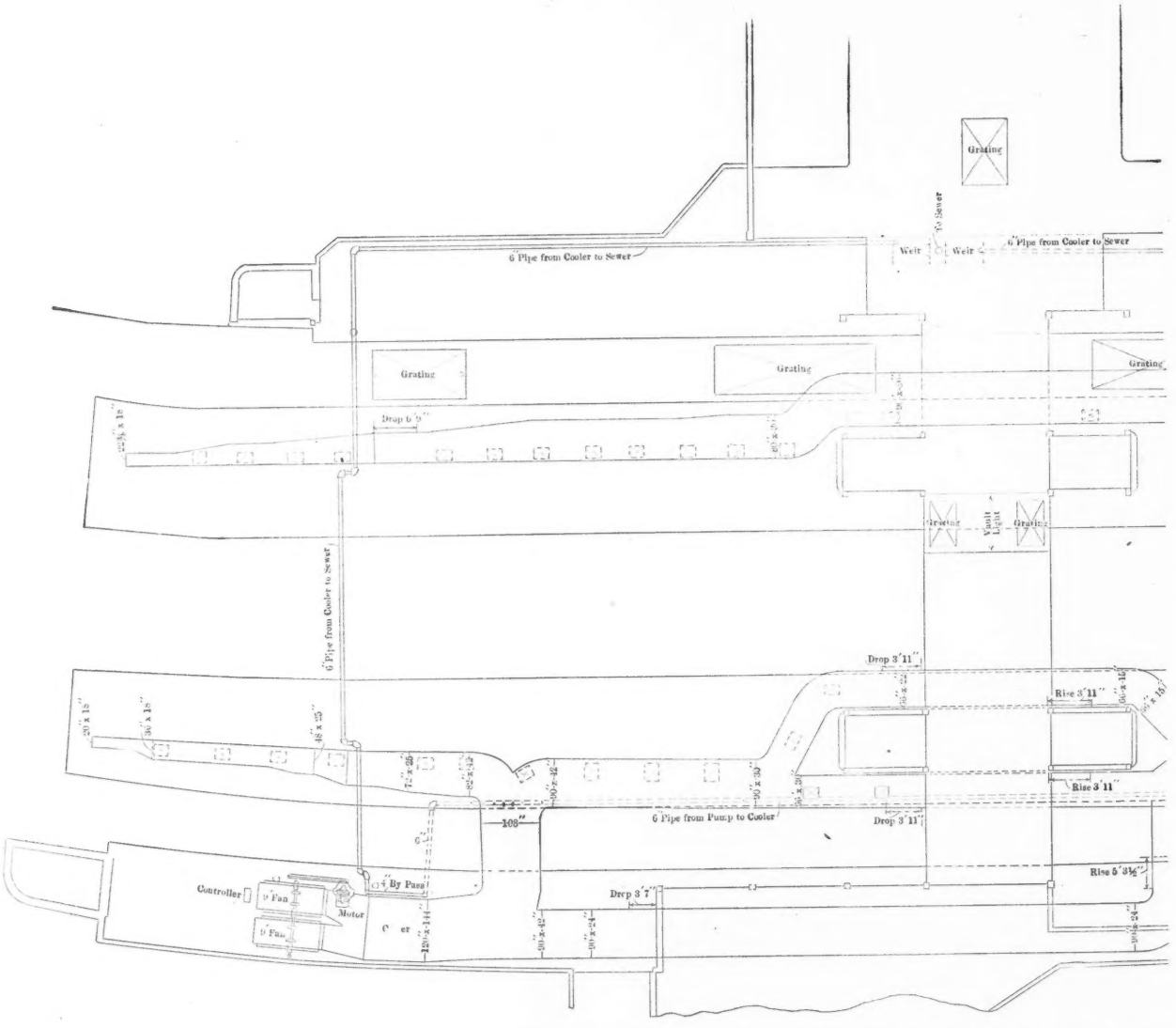


DIAGRAM SHOWING RELATIONS OF THE VARIOUS ELEMENTS OF THE EXPERIMENTAL COOLING

The work of improving the ventilation consisted primarily in cutting openings in the vault lights from the Brooklyn Bridge station to the Ninety-sixth street station, inclusive, and installing gratings therein. About 5,000 square feet of vault lights have been cut out and gratings installed, providing approximately 2,500 square feet of additional effective opening at the stations for the inlet of air. The immediate result of these openings was an improvement in the conditions at the stations. The warm air which had been found under the vault-lights was released, and the temperature in the stations responded more nearly to outside changes. The effect was most noticeable, however, directly under the openings.

In addition to the opening of the vault-lights there were fourteen ventilating chambers constructed adjacent to the subway between the Brooklyn Bridge station and the Columbus Circle station. These chambers provide outlets for the air be-

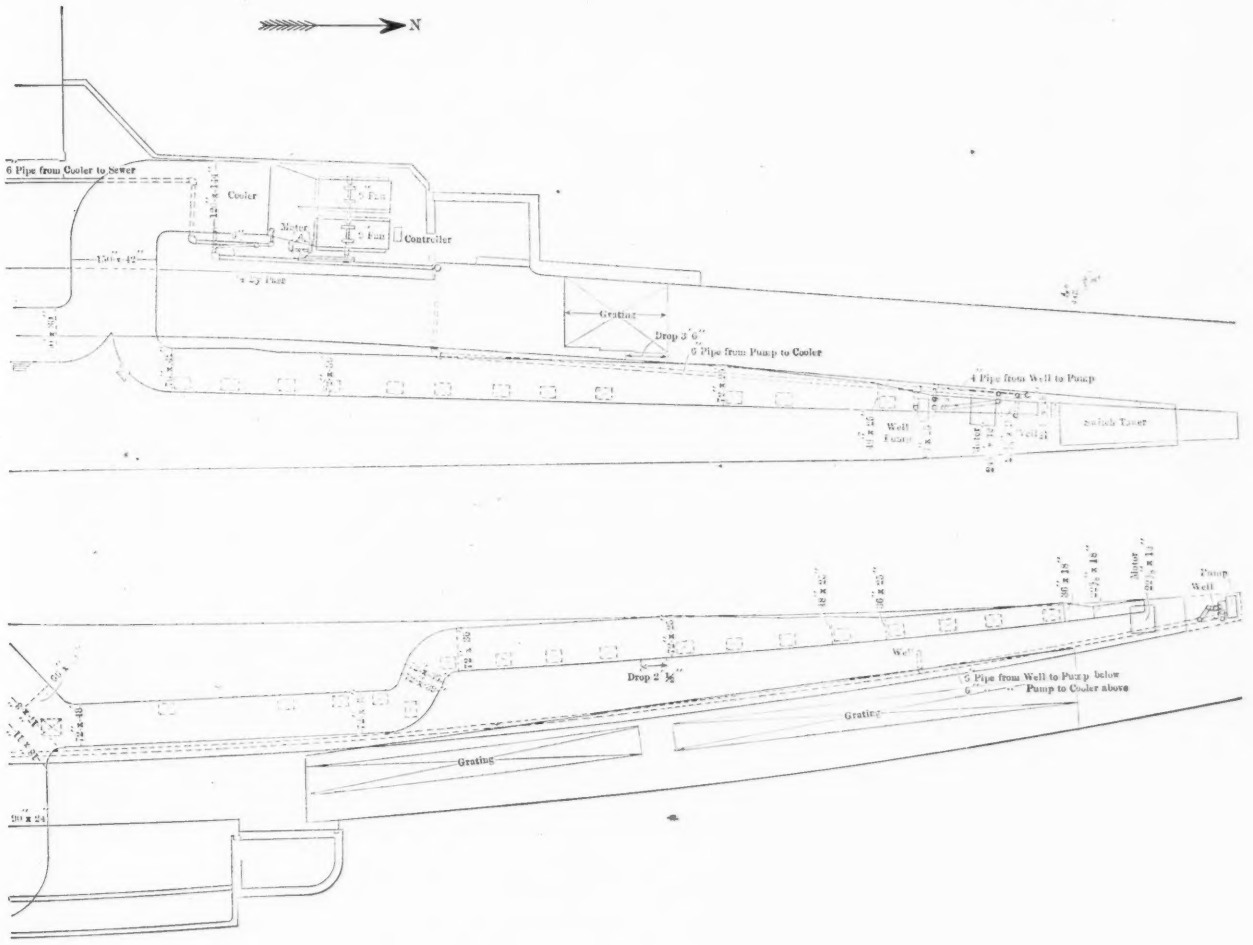
tween the stations. At these outlets the air is exhausted during the daytime by automatic louvres, and at night by motor-driven fans. Where the ventilating chambers have been cut through into the subway an immediate change has been noticed, a local effect being produced similar to that produced by the gratings at the stations.

Between the Columbus Circle station and the Ninety-sixth street station automatic louvres have also been installed. With the complete system of louvres and fans in operation the circulation of the entire system has been very greatly improved.

One of the most interesting features of this work, however, has to do with the experimental cooling plant installed at the Brooklyn Bridge station. The cooling plant consists of two separate units, one for the west half of the station and one for the east half. The accompanying illustration shows the relations of the various parts of these units. Each unit consists of the following parts: two separate housed steel-plate fans nine feet in diameter on one shaft for driving the air. The capacity of the two fans is 75,000 cubic feet of air per minute at 175 revolutions per minute. One C & C forty-horse-power direct-current motor wound for a normal speed of 800 revolutions per minute, running on a 625-volt circuit, for driving the two fans. One Cutler-Hammer "Universal" speed-regulator for controlling the speed of the motor. One forty-horse-power Renold silent chain drive for connecting the motor to the shaft of the fans. A coil of 22,080 linear feet of one-inch galvanized wrought-iron pipe (enclosed in a galvanized sheet-iron casing), over which air is blown for cooling. A system of galvanized sheet-iron ducts with openings for distributing the air in the station. Two wells for supplying water to the coils. One Deane triplex double-acting pump for driving the water through the coils. One fifteen-horse-power direct-current motor for driving the pump. One Cutler-Hammer "Universal" speed regulator for controlling the motor. Wrought-iron water-pipe with fittings leading from the pump to the cold-water coils and from the coils to the city sewer.

The blower fans were furnished by the American Blower Company, New York city. As may be seen from the accompanying illustration, these blowers are in duplicate. The blowers take the air directly from the inside of the station, and are designed to drive 37,500 cubic feet of air per minute each at 175 revolutions per minute. These two fans are driven by one forty-horse-power direct-current motor made by the C & C Electric Company, New York city. The Cutler-Hammer No. 45 "Universal" speed regulator which controls the speed of the motor is well shown in the accompanying illustration.

The warm air from the inside of the station is blown by the fans over the



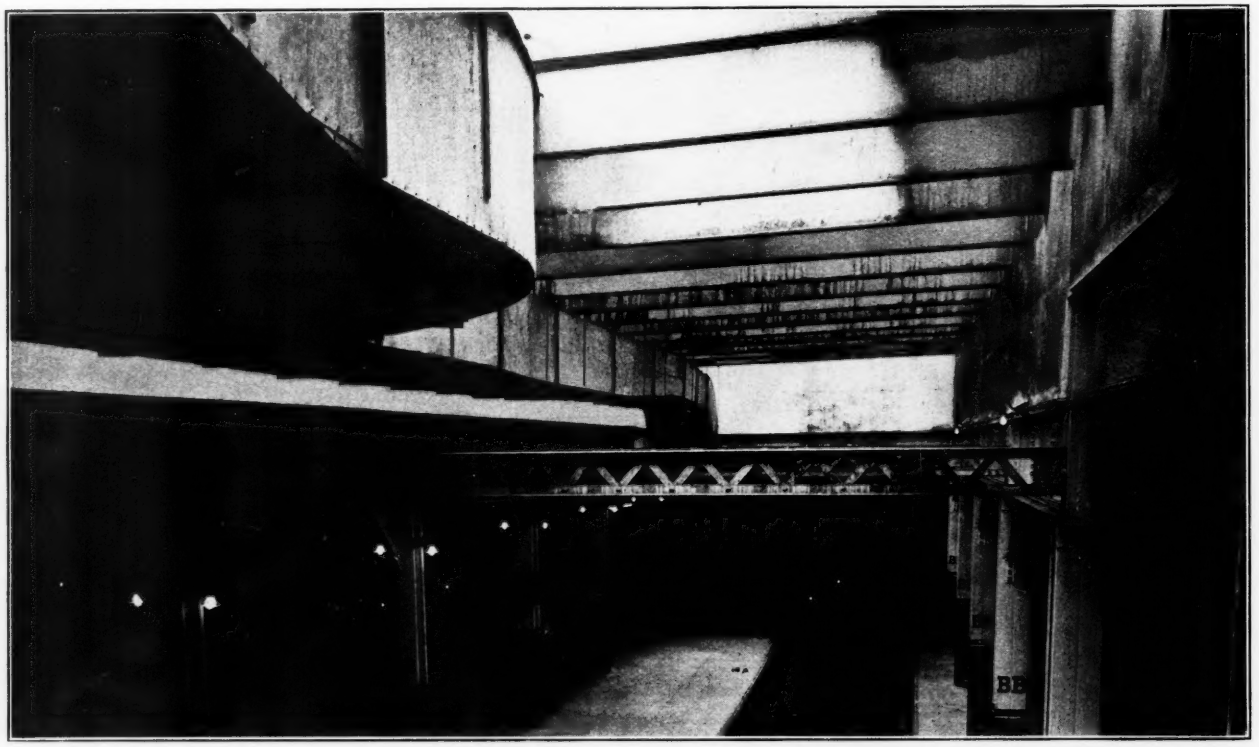
PLANT INSTALLED AT THE BROOKLYN BRIDGE STATION OF THE NEW YORK CITY SUBWAY.

cooling coils, which are encased in a galvanized sheet-iron casing. After the air passes over the cooling coils it is again distributed to the interior of the station by means of a system of galvanized sheet-iron ducts which is run above the island platforms and suspended from the roof of the station.

One of the illustrations gives a good idea of the general appearance of the duct system. The velocity of air through the ducts is about 1,720 feet per minute, discharging about 75,000 cubic feet of air per minute. Openings for discharging the air into the station are cut in the bottom of the ducts. These openings are twenty inches by twenty-eight inches, spaced ten feet from centre to centre. For discharging the 75,000 cubic feet of air per minute there are thirty-two such openings, so that 2,340 cubic feet per minute are discharged through each opening, which has an area of 3.89 square feet, the velocity of discharge being 602 feet per minute. In operation the air is discharged at an angle of about forty-five degrees to the horizontal, without the presence of deflecting dampers, which, however, have been placed inside the ducts and cause the air to discharge directly downward. Also, gratings which have been put over the openings will somewhat affect the area of the opening and the velocity of discharge given above. The ducts are reduced in size at each opening, and have a section eighteen inches by twenty inches at the extreme end, which is left open.

The cold-water coils are built in three sections, placed one above the other. Each section consists of sixteen pipes vertically and forty-six pipes horizontally. The pipes are one-inch galvanized wrought iron, put together with galvanized return bends. The sixteen horizontal rows of pipes are connected in multiple at each end with a header or branch T. Each header is of three-inch galvanized wrought iron capped on the ends, with a three-inch T in the centre, tapped on one side for sixteen one-inch outlets. The three sections of the coil are connected up separately to the cold-water main with a gate valve for each section, so that each section may be regulated independently of the others. The water flows through the coils against a current of air, and is then discharged into the city sewer. Each of the three sections of the coil is vented at the top with a three-eighths-inch pipe and cock to facilitate the discharge of entrapped air. The general outside dimensions of the completed coil are about ten feet long by nine feet wide by twelve feet six inches high. The coils are enclosed in galvanized sheet-iron casings, and the completed sets of coils are braced to the subway columns for rigidity.

For securing a supply of cold water four wells have been sunk, two on the north end of each of the two island platforms. These wells have an eight-inch wrought-iron casing extending twenty-nine feet eight inches down from the top of the platform, and a six-inch wrought-iron suction pipe extending forty-six feet from the top of the platform. Each well is equipped with a copper strainer twelve feet six inches long, and the bottom of the pit is four feet two inches below the top of the platform. From the bottom of the pit to the water level the well is fifteen feet two inches, and from the top of the platform to the water level the distance is nineteen feet four inches. From the water level to the bottom of the strainer the distance is about thirty-six feet eight inches. For lifting the cold water from the wells and driving it through the coils two Deane triplex double-acting pumps are used, one for each half of the station. These pumps are six inches in diameter by eight inches stroke, with a five-inch suction and four-inch discharge. The displacement of each pump is 5.87 gallons per revolution, or 200 gallons at thirty-four revolutions per minute, and 264 gallons at forty-five revolutions per minute. Each of the Deane



THE AIR-DUCT SYSTEM USED IN CONNECTION WITH THE EXPERIMENTAL COOLING PLANT IN THE NEW YORK CITY SUBWAY OF THE INTERBOROUGH RAPID TRANSIT COMPANY.

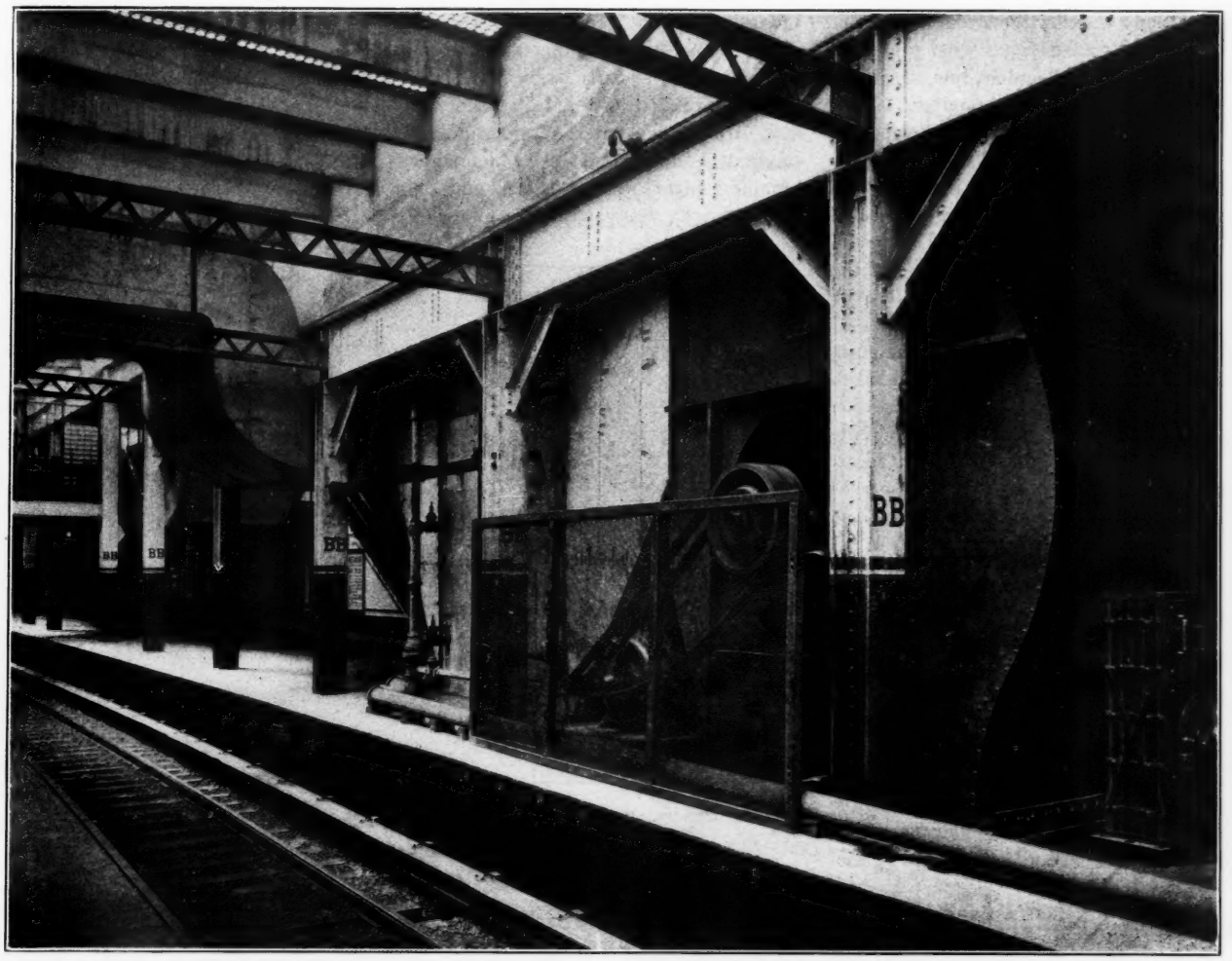
pumps is driven by a leather belt from a fifteen-horse-power, direct-current, variable-speed motor made by the C & C Electric Company. The speed variation of the motors is from 700 revolutions to 1,400 revolutions per minute, the voltage 550 to 750. Each of the two motors is controlled by a Cutler-Hammer No. 24 "Universal" speed regulator.

The blower and motor system, with its speed-regulating controller, and the pumping outfit, with its motor and controller, are identical for both the west and east sides of the station. The two duct systems are also similar in design and dimensions. The coil erected on the northbound local platform is the same as that on the southbound local platform, which has been described, with the exception that the third, or top, section has fifteen instead of sixteen horizontal rows of one-inch pipes, on account of the low ceiling in the station.

The effect of the operation of this cooling system was immediately noticeable. At midnight of August 29, or after the system had been in operation for fourteen hours, the average temperature in the station had been lowered seven degrees down to seventy-five degrees, the same temperature as the outside air. The plant is operated on week-days from 7 A. M. to 8 P. M., and on Sundays from 10 A. M. to 8 P. M. The air as it is discharged from the ducts directly over the platform has been noted to be from three to six degrees cooler than the average temperature in the station. The passengers therefore obtain the immediate benefit of this additional cooling before it has been diffused throughout the station. Because of this the plant is operated only during the daytime. In warmer weather, however, it may be necessary to operate it continuously for twenty-four hours.

An interesting fact has been noted in connection with this cooling system. Before the cooling plant was put in operation the Brooklyn Bridge station was always from two to six degrees warmer than the Fourteenth street and Grand Central stations, while after the plant was operated the reverse condition existed; that is, the Brooklyn Bridge station was from two to four degrees cooler than the Fourteenth street and Grand Central stations.

The installation of the cold-water coils was made by the James Curran Manufacturing Company, New York city. The artesian wells were sunk by F. W. Miller, New York city, and the duct work was sublet by the American Blower Company to the Thompson-Starrett Company, New York city.



EXPERIMENTAL COOLING PLANT, NEW YORK CITY SUBWAY OF THE INTERBOROUGH RAPID TRANSIT COMPANY.

Wireless Telegraph Conference.

About 100 delegates to the wireless telegraph conference now sitting at Berlin are in attendance. The following countries are represented: Argentina, Austria-Hungary, Belgium, Brazil, Hungary, Chili, Denmark, Egypt, Germany, Greece, Great Britain, Italy, Japan, Mexico, Monaco, Montenegro, the Netherlands, Norway, Prussia, Portugal, Roumania, Russia, Siam, Spain, Sweden, the United States and Uruguay. Turkey has failed to reply to the invitation and China and Peru declined to send representatives.

Stress in Magnetized Iron.

Maxwell's theory indicates that there should be a stress in magnetized iron directly proportional to the square of the induction. The question was raised some time ago, whether this stress is compressive or tensional. Recently Shelford Bidwell expressed the opinion that this was a compressive stress, comparing it to the action of two magnetized bodies, which are attracted together and will compress any matter lying between them. C. Chree questions here whether this view is correct, and whether the stress should not be tensional, such as would exist if a series of magnets were placed in line, separated a short distance from one another. Each magnet would then attract the opposing poles of its neighbors, and thus would exert and have exerted upon it a tensional stress. In other words, if the centres of the magnetized particles be fixed, they will be subjected to a tensional stress. If the spaces between them be filled with some material, the latter will not be compressed unless the tensional stress of the magnetized particles causes them to be extended. The author considers the evidence which has been presented insufficient to decide finally in favor of either of the two ideas, and asks for further light upon the subject.—*Nature* (*London*), *September* 27.

ELECTRICAL MINE PUMPS AT THE WARD SHAFT.

BY LEON M. HALL.

The pumping plant just received at the Ward shaft, Virginia City, Nev., is probably the largest, best and most complete electrically driven mine-pumping installation ever constructed, so that a brief description of the same, together with the reasons for its existence, may be of interest to those engaged in the mining and electrical industry.

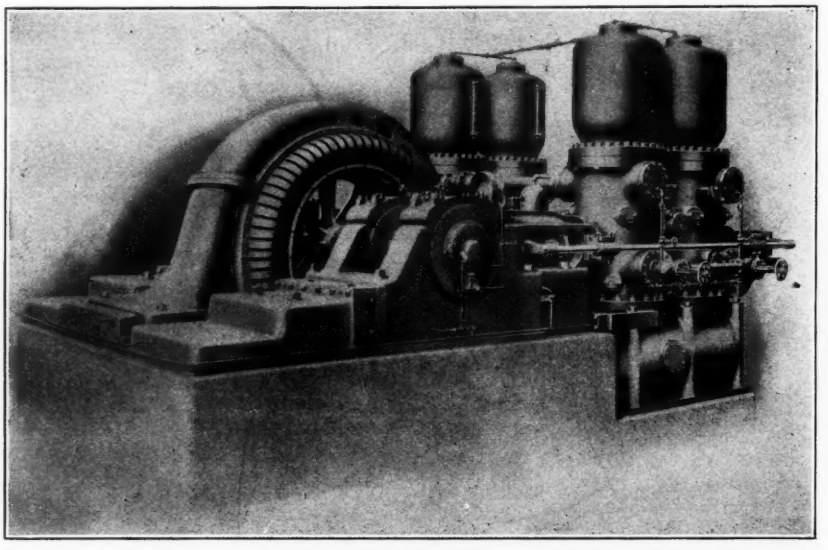
The Ward Shaft Association was formed some three years ago with the ostensible purpose in view of opening the Ward shaft and of draining the middle group of mines on the Comstock, in order to explore this lode to its very lowest depths. This shaft was originally sunk to a vertical depth of 2,480 feet, and just before reaching this point had passed through the vein, which proved to be a mineralized fissure over sixty feet in width. Some fifteen years ago this shaft was abandoned on account of the stagnation then existing in the silver market, and, with the cessation of work, it was allowed to decay and partially fill with rock and refuse of all kinds.

The shaft was rehabilitated and retimbered without much trouble to the 1,600-foot level, at which point a drainage drift was run 275 feet to connect with the South Lateral branch of the Sutro tunnel. Below this level difficulties of all kinds incident to hot water and its attending evils were encountered, and the progress has consequently been slow and expensive. To-day the shaft is in perfect condition to the 2,430-foot level, leaving but fifty feet of the old shaft to recover. From the 2,480 to the 3,100-foot level the work will all be in new ground, probably free from water, so that it is confidently expected that progress will be rapid and the new electric pumps in early operation.

In reopening this shaft a considerable flow of very hot water was encountered, so that quite an extensive temporary pumping plant was necessary, and this will be briefly described in the following:

In order to supplement this plant, a five-step Byron Jackson centrifugal pump, directly connected to a special Westinghouse induction motor, has been installed on the 2,410-foot level. This pump has a capacity of 600 gallons per minute against a head of 900 feet and it will take its supply of water directly from the sinking pump, thereby doing away with the triplex and centrifugal pumps before mentioned. This pump is entirely of bronze, operates at 1,700 revolutions per minute, and under these conditions shows an efficiency of sixty-seven per cent with the water temperature 160 degrees Fahrenheit. This pump will be duplicated immediately for safety of operation, and, with these as an auxiliary, the company confidently hopes to reach the 3,100-foot level at no distant day.

On the 3,100-foot level the excavation



DUPLEX, OUTSIDE PACKED, PLUNGER ELECTRIC POWER PUMP. CAPACITY, 1,600 GALLONS PER MINUTE, AGAINST 1,550-FOOT HEAD AT 195 REVOLUTIONS PER MINUTE.

On the 2,100-level a six-and-three-quarters-by-eight-inch Knowles vertical triplex pump, geared to a 100-horse-power induction motor, was placed and arranged to take its water from a three-step Byron Jackson centrifugal pump belted to a fifty-horse-power induction motor, located on the 2,330-foot level. In turn, this centrifugal receives its supply from a nine-inch Blake sinking pump at the bottom of the shaft. Two 100-horse-power Ingersoll-Sergeant compound air-compressors, driven by two 100-horse-power motors, are in operation on the surface and supply this sinker with the necessary motive power. This temporary plant is raising 300 gallons per minute 855 feet, from the present sump to the Sutro tunnel level.

of a pump station eighty feet long, twenty-four feet wide and twenty feet high is contemplated, in which will be placed the permanent pumping plant, the real subject of this sketch.

The capacity of this permanent installation will be 3,200 United States gallons per minute against a total head of 1,550 feet, and this will be divided between two units each separately driven by a special slow-speed 800-horse-power Westinghouse induction motor. The pumps are of the Knowles express type and are the embodiment of all of the best mechanical and electrical ideas obtainable for this class of work. They are outside, end-packed, duplex, double-acting pumps with plungers six and eleven-sixteenths inches in diameter and fifteen inches stroke. The

rotating element of the motor is placed directly on the crank shaft and they will operate at 195 revolutions per minute.

The valves are automatic poppet valves arranged in nests of thirteen each. The valve area (103.35 square inches) is unusually large, so that the consequent movement of the valves is extremely small, all of which is conducive to a high rotative speed with a minimum of wear. The valves, stuffing-box glands and other vital parts exposed to the action of the water are of bronze and are arranged so that they may be readily renewed.

The plant will be equipped with a three-stage electrically driven air-compressor for charging the air-receivers, a vacuum pump and an automatic oiling system. For convenience of erection and repair, the pump station will be fitted with a fifteen-ton traveling crane; in fact, it is intended to include in this plant everything that will ensure reliability and ease of operation.

The over-all dimensions of each pump are twenty-seven feet three and three-quarter inches in length, seventeen feet in width and fourteen feet two and one-half inches in height. The motor is thirteen feet in diameter, and the steel crank shaft, forged from one piece, is thirteen and three-quarter inches in diameter and fourteen feet four and one-half inches long. The total cost complete for operation will be about $125,000. These pumps will be supplied by either one of the two centrifugals located in the sump at the bottom of the shaft and operated by special seventy-five-horse-power Westinghouse motors on a vertical shaft.

The water will be discharged through sixteen-inch outside diameter steel column with welded steel flanges. The thickness of this pipe varies from one-quarter inch at the tunnel level to nine-sixteenths inch at the bottom. The column will be supported by means of heavy-weight iron clamps, six inches in length, which, in turn, will rest upon the wall and end plates. To resist the pressure of 675 pounds to the square inch, male and female flanges are used and each fitted with a lead-filled copper gasket.

The electric current is taken down the shaft at 2,240 volts over a three-conductor, lead-covered, steel-armored cable of 400,000 circular mils capacity. The electric equipment, from the automatic oil circuit-breakers on the surface to the motors themselves, is the best that money can buy, so that, once in operation, with the plants of the Truckee River General Electric Company behind it, results are expected that have never before been approached for this class of work.

THE THEORY OF "MOVING COIL" AND OTHER KINDS OF BALLISTIC GALVANOMETERS.[1]

BY PROFESSOR HAROLD A. WILSON, F.R.S.

A formula which is usually given for ballistic galvanometers is

$$Q = \frac{H\,T}{G\,\pi} \sin \frac{\theta}{2},$$

where Q = quantity of electricity passed through galvanometer.
H = magnetic field controlling the galvanometer needle.
G = magnetic field at needle, supposed perpendicular to H, due to unit current in the coil.
T = time of a complete oscillation of the needle.
θ = angle of swing of the needle from rest, corrected for damping.

If ϕ is the steady angular deflection due to a current i, then $i = \frac{H}{G} \tan \phi$; so that

$$Q = \frac{T\,i \sin \theta/2}{\pi \tan \phi}.$$

The above formulæ are, of course, strictly speaking, only applicable to ballistic galvanometers consisting of a coil of wire having a single small magnet freely suspended at the centre of the coil, and arranged so that at its equilibrium position the axis of the magnet is in the plane of the coil.

In the following paper the proper formulæ for ballistic galvanometers of several types in general use are obtained, and it is found that in several cases they differ appreciably from the above.

In Professor Fleming's "Handbook for the Electrical Laboratory and Testing Room," vol. ii., the formula for a moving coil galvanometer is worked out; but owing to an approximation used in the calculation it is not obtained exactly, and it is afterwards given as applying to both moving-coil and moving-needle galvanometers.

The first type of galvanometer that will be considered is the moving-coil type with a rectangular coil, cylindrical iron core and cylindrical pole-pieces symmetrically arranged. In galvanometers of this type the magnetic field is approximately radial, so that the couple on the coil due to a steady current is proportional to the current and independent of the deflection. The controlling couple is due to the torsion of the wire by which the coil is suspended, so that the work required to turn the coil through an angle θ from its zero position is $\frac{a\,\theta^2}{2}$, where a is the couple exerted by the wire when the coil is turned through the unit angle. Let $C\,i$ denote the couple due to a current i, then we have $C\,i = a\,\phi$. When a current i is passed through the galvanometer for a short time $d\,t$, we have

$$C\,i\,d\,t = C\,d\,Q \quad K\,d\,\omega,$$

where K is the moment of inertia of the coil and ω its angular velocity. Hence

$$Q = \int i\,d\,t = \int \frac{K\,d\,\omega}{C} = \frac{K\,\omega}{C}.$$

We have also

$$T = 2\,\pi \sqrt{\frac{K}{a}} \text{ and } \frac{a\,\theta^2}{2} = \tfrac{1}{2}\,K\,\omega^2;$$

hence

$$T = 2\,\pi \sqrt{\frac{\theta^2}{\omega^2}} = \frac{2\,\pi\,\theta}{\omega}.$$

Thus

$$Q = \frac{K\,\omega}{C} = \frac{a\,\theta^2}{C\,\omega} = \frac{T\,a\,\theta}{2\,\pi\,C}.$$

But $\frac{a}{C} = \frac{i}{\phi}$; so that finally

$$Q = \frac{T\,i\,\theta}{2\,\pi\,\phi} \text{ exactly.}$$

Since the couple on the coil due to the current is independent of θ, it is not necessary with this type of instrument that the time during which the transient current passes should be very small compared with T.

Another type of moving-coil instrument in common use has a narrow coil suspended between the poles of a magnet and no iron core. In this case the couple on the coil due to a current, i, will be nearly $C\,i \cos \phi$. so that $C\,i \cos \phi = a\,\phi$ or $\frac{a}{C} = \frac{i \cos \phi}{\phi}$; hence the exact formulæ for this type of instrument are

$$Q = \frac{T\,a\,\theta}{2\,\pi\,C} = \frac{T\,i\,\theta \cos \phi}{2\,\pi\,\phi}.$$

In these formulæ it is assumed that the plane of the coil at its zero position is parallel to the magnetic field.

It appears, therefore, that the first type of moving-coil ballistic galvanometer considered is superior to the second in respect of the simplicity of the exact formulæ to be used with it, and the absence of error when the transient current lasts an appreciable time.

Moving-needle instruments will now be considered. The formulæ

$$Q = \frac{H\,T \sin \theta/2}{G\,\pi} \text{ and } Q = \frac{T\,i \sin \theta/2}{\pi\,\phi}$$

apply to what may be called a tangent ballistic galvanometer. The time of the

[1] Paper read before the Physical Society of London.

transient current must of course be small compared with T, and its greatest value must not be sufficient to appreciably change the magnetism of the needle.

In many ballistic galvanometers an astatic system of needles is used. First, suppose the system is exactly astatic and that the torsion of a wire or quartz fibre supplies the controlling couple. In this case, $C\ i \cos\phi = a\ \phi$ and $K\ \omega^2 = a\ \theta^2$, so that the formulæ are

$$Q = \frac{T\ a\ \theta}{2\ \pi\ C} = \frac{T\ i\ \theta \cos\phi}{2\ \pi\ \phi},$$

as with the second type of moving-coil instrument. Also $C = M\ (G_1 + G_2)$, where M is the moment of each needle and G_1 and G_2 the fields due to unit current at the two needles respectively.

One other case will be considered—*viz.*, when the needle system is more or less astatic and is controlled by magnetic fields at each needle. Let the horizontal component of the controlling field at one needle be H_1 making an angle a_1 with the plane of this needle, and let M_1 be the moment of this needle. Let M_2, H_2 and a_2 be the corresponding quantities at the other needle. Then in the equilibrium position,

$$0 = M_1 H_1 \sin a_1 + M_2 H_2 \sin a_2.$$

The controlling couple when the needle is deflected through an angle ϕ is

$$M_1 H_1 \sin(\phi + a_1) + M_2 H_2 \sin(\phi + a_2) = \{M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2\} \times \sin\phi:$$

and if ϕ is the deflection due to a current i, then

$$i\ M_1 G_1 \cos\phi + i\ M_2 G_2 \cos\phi = \sin\phi\ \{M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2\}.$$

Hence

$$i = \frac{M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2}{M_1 G_1 + M_2 G_2} \tan\phi.$$

It can now be easily seen that the formulæ for a ballistic galvanometer of this type are

$$Q = \frac{T\ (M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2) \sin\theta/2}{\pi\ (M_1 G_1 + M_2 G_2)}$$

$$\text{and } Q = \frac{T\ i \sin\theta/2}{\pi \tan\phi}.$$

So far the correction of the observed deflection θ for damping has been neglected. The method usually described depends on the "logarithmic decrement," and is cumbrous and, moreover, inexact unless the damping is very small. The following method has the great advantages of simplicity and exactness; it is not new: the writer learned it about ten years ago from Professor W. Stroud.

Let θ_1, θ_2, θ_3, etc., be the successive swings of the galvanometer needle. Then

$$\frac{\theta_1}{\theta_2} = \frac{\theta_2}{\theta_3} = \frac{\theta_3}{\theta_4} = \text{etc.} = f \text{ say.}$$

To find f observe, say, θ_1 and θ_3, or θ_1 and θ_5. Then

$$f^2 = \frac{\theta_1}{\theta_3} \text{ or } f^4 = \frac{\theta_1}{\theta_5}.$$

Also the corrected value of the first swing is

$$\theta_1 \sqrt{f} = \theta_1 \left(\frac{\theta_1}{\theta_3}\right)^{1/4} = \theta_1 \left(\frac{\theta_1}{\theta_5}\right)^{1/8}.$$

In most cases the angular deflections may be taken as proportional to the deflections on the scale. Let these be δ_1, δ_2, δ_3, etc. Then the corrected value of the first swing is

$$\delta_1 \left(\frac{\delta_1}{\delta_3}\right)^{1/4} \text{ or } \delta_1 \left(\frac{\delta_1}{\delta_3}\right)^{1/8}.$$

If the damping is small the corrected value is very nearly $\delta_1 + \frac{1}{4}\ (\delta_1 - \delta_3)$ and this formula is sufficiently exact for most purposes in practice.

The following table contains a summary of the results obtained:

Type of Galvanometer.	Formulæ.
(1) Tangent galvanometer with small needle at centre of coil.	$Q = \frac{H\ T}{G\ \pi} \sin\frac{\theta}{2}$, $Q = \frac{T\ i \sin\theta/2}{\pi \tan\phi}$.
(2) Astatic galvanometer with purely torsional control.	$Q = \frac{T\ a\ \theta}{2\ \pi\ M\ (G_1 + G_2)}$, $Q = \frac{T\ i\ \theta \cos\phi}{2\ \pi\ \phi}$.
(3) Astatic galvanometer with purely magnetic coil.	$Q = \frac{T\ (M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2)}{\pi\ (M_1 G_1 + M_2 G_2)} \sin\frac{\theta}{2}$ $Q = \frac{T\ i \sin\theta/2}{\pi \tan\phi}$.
(4) Moving-coil galvanometer with iron core and radial magnetic field.	$Q = \frac{T\ a\ \theta}{2\ \pi\ C}$, $Q = \frac{T\ i\ \theta}{2\ \pi\ \phi}$.
(5) Moving-coil galvanometer with narrow coil and no core.	$Q = \frac{T\ a\ \theta}{2\ \pi\ C}$, $Q = \frac{T\ i\ \theta \cos\phi}{2\ \pi\ \phi}$.

It will be seen that type (4) is superior to all the others as regards the simplicity of the exact formula to be used with it. It is also superior in most other respects. Galvanometers are often met with in practice which, strictly speaking, do not belong to any of the simple types considered in this paper. In such cases the exact formulæ are more complicated, and the best plan to adopt is to determine experimentally the relation between θ and Q.

New York City Railway Earnings.

Gross earnings of the New York City Railway Company, lessee of the Metropolitan system, for the year ended June 30 were $21,937,944, an increase of $1,047,820. Operating expenses were $12,624,783, an increase of $353,959, and net earnings of $9,313,161; an increase of $696,461. The charges overbalanced the earnings, amounting to $11,950,903, so that the statement for the year shows a deficit of $2,212,997. In the previous year the deficit was $583,946 greater.

The special franchise tax is not included in the charges. The amount of this for the fiscal year is approximately $537,000. Proceedings are pending which, the report says, are expected to result in a substantial reduction in this amount. The deficit will be further increased by the amount of the special franchise tax when it is ascertained by the courts.

The report covers the first full year of competition with the subway, and President Vreeland notes that the increase of five per cent in the gross earnings "realizes the expected recovery and adjustment of the surface railroad traffic under new conditions, indicating that the increase in the short haul business is rapidly overcoming the loss of long haul traffic that has gone to the subway."

The fixed charges for the year included the increase in the annual rental payable under the lease of the Third avenue line which for four years, from April 13, 1906, is at the rate of six per cent, as against five per cent for the preceding two years. A saving in fixed charges was, however, effected by refunding the bonds of various small subsidiaries. The report adds:

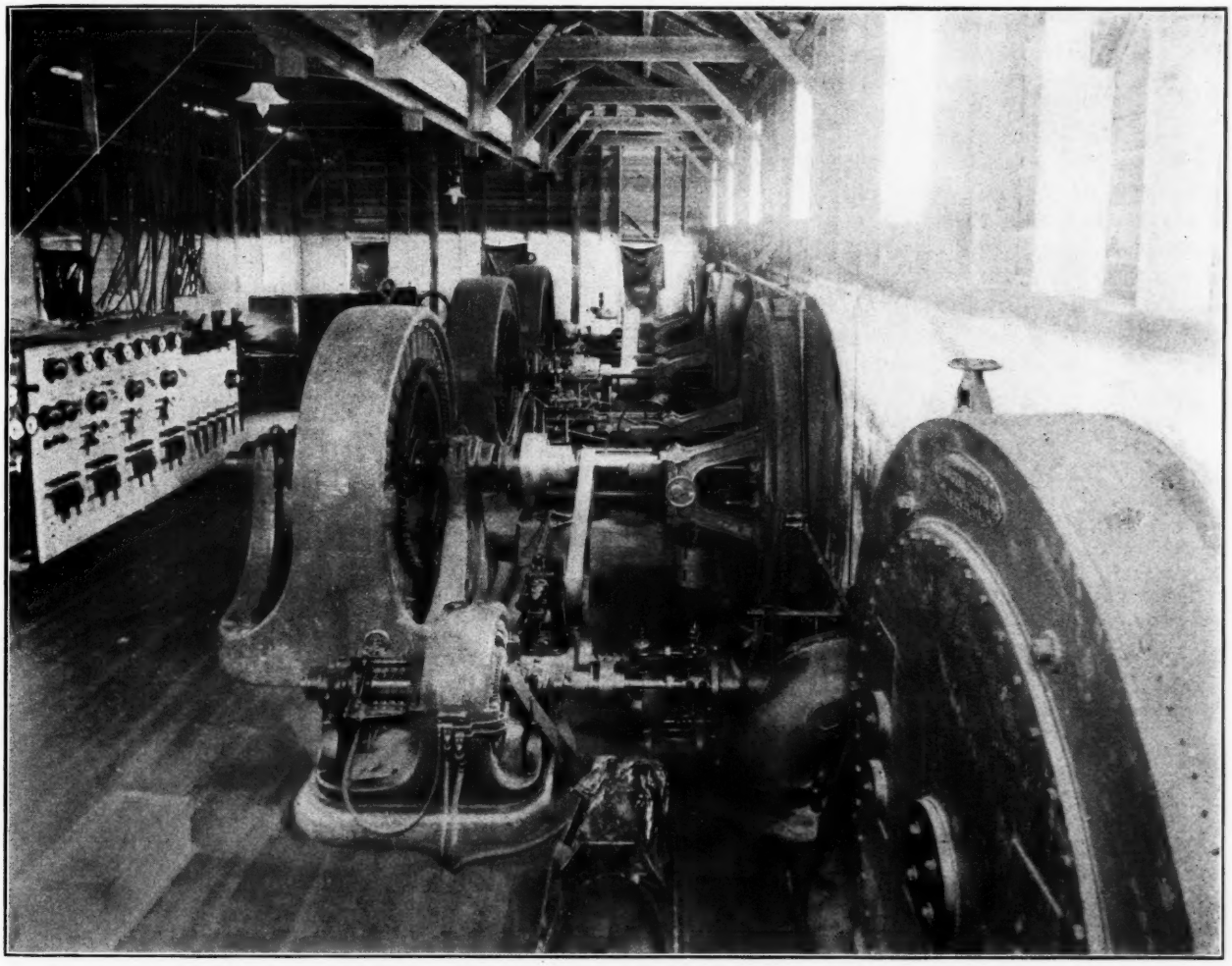
"The equipment of the company during the year was increased by the purchase of twenty-five long open and twenty-five semi-convertible cars, which cars are now in operation. In addition twenty-five large closed cars are now being built for delivery early in the fall. Applications have been made and are now pending for about fifteen miles of double track extensions in the borough of The Bronx and its outlying district, which extensions if granted, will develop new territory and meet the local demand for additional transportation facilities."

Hydroelectric Power Plant and Transmission Lines of the North Georgia Electric Company.

By R. W. Hutchinson, Jr.

PROMINENT among the hydraulic developments in the South, considering energy developed and transmitted, distance of transmission, thoroughness of design, stability of construction and number of power sites that will eventually be linked together, stands out the work of the North Georgia Electric Company, now completing two of its first developments on the Chestatee and Chattahoochee rivers near Gainesville, Ga. This company is now building a steel tower transmission line—the first in the South—to transmit its power to Atlanta, about fifty miles distant.

From a power-transmission viewpoint, the company completely circumvallates the city of Atlanta, controlling as it does the more important powers on the Etowah, Tallulah, Chattahoochee and Ocumulgee rivers, all of which are within the radius of economical transmission to several points of consumption, the largest of which, however, is Atlanta. This monopoly of water powers is a measure of self-protection which, as was outlined in a paper by Dr. F. A. C. Perrine before the American Institute of Electrical Engineers, in June, 1905, Southern water-power companies must adopt to prevent dangerous competition. The water powers in the South are so numerous and some are so variable that, to insure continuous service at or near maximum-load condition, success for the operating company is contingent upon its controlling all of the water power which can economically supply all of the territory that its development covers. The location of the power plant in northern Georgia, very accessible to the Tennessee and Alabama coal fields and hence subject to the competition of high-grade steam coal, demands for successful operation development on a large scale, with operating and depreciation costs per unit of output reduced to a minimum; and also demands a continuous twenty-four-hour-per-day period of operation. In all these necessary factors the North Georgia Electric Company has been far-sighted.



Interior of Generating Plant, North Georgia Electric Company.

It is considered that Atlanta has a great future, and that it is destined to be the manufacturing and commercial centre of the South, which means that the future need for power will be large; and it is the purpose of the North Georgia company to develop and transmit power as occasion justifies, meanwhile holding in reserve its accumulation of Nature's

wealth. The powers that have been developed, and those held in reserve, are primarily intended for transmission to Atlanta for utilization in lighting and street railway service—and possibly for future interurban railways which may be economically operated in the territory covered by the transmission lines.

The drainage area of the Chattahoochee river up to the point of the power plant covers a trifle over 544 square miles, the watershed being a rough and mountainous country. The catchment area, however, is relatively large and most of the water falling on the mountain slopes is drained directly into the Chattahoochee. The runoff of the stream near this point is, in ordinary seasons, about 3.5 second-feet per square mile during the spring and summer, and about four second-feet per square mile during the winter. The mean discharge in second-feet averages 2,500 during the winter and 2,000 during the summer season. In exceptionally rainy seasons the discharge may be as high as 17,000 second-feet. Hence it is obvious that to take care of such variations in flow requires a very careful and substantial construction of dam and accessories.

The largest development of the company is on the Chattahoochee river near Gainesville. The dam is a log-crib, rock-filled structure thirty-seven feet high, with double-planked spillway, apron and upstream face. It is approximately 300 feet long and is built perfectly straight. The dam of the other development of the company, on the Chestatee river—a tributary of the Chattahoochee, fifteen miles from Gainesville, is about the same height and is also a log-crib, rock-filled structure.

All the materials of construction used in these dams were obtained from the neighborhood of the dam sites. The base of the dam on the Chattahoochee is about ninety feet in width and is constructed of local stone and cement mortar. A kind of forebay is formed on the sheltered side of the stream by blowing out the river bank, the selection being such that wind and current tend to carry driftwood, trash, etc., to the other side, so that little trouble from this source obtains. The bulkhead of the dam assists in forming the forebay, and carries the racks, head-gates and flood-gates; and also serves to shelter the power-house. A tailrace was formed by blasting out the river bed at the power-house, and an elevation of the bottom obtained the same as that of the river bed below the shoals. In this way the desired head is secured with a saving of several feet in the height of the dam, and hence saving in cost.

The power-house building is a wooden structure of Georgia pine with concrete floor and is covered with corrugated, galvanized-metal roofing which is intended, however, to be temporary. The building is supported on concrete piers just above the tailrace and immediately behind the bulkhead. The floor of the power-house is an extension of the abutment of the dam, and is constructed at such a height above tail-water that the centre line of the generators, when resting on the power-house floor, comes in line with th

Power-House and Dam, North Georgia Electric Company, Gainesville, Ga.

centre line of the turbine shafts to which they are direct-connected.

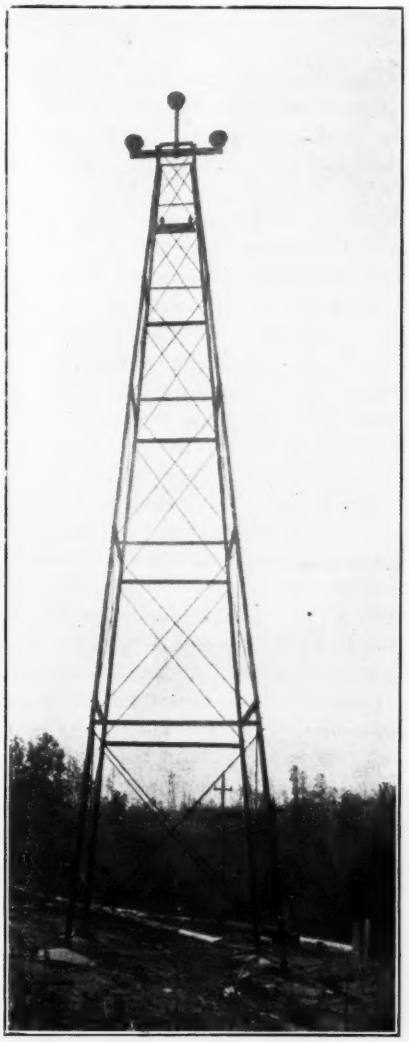
At the present writing three turbines have been installed, the number to be eventually installed being seven. These turbines comprise two wheels on each shaft, of the horizontal type, and made by the S. Morgan Smith Company. The turbine cases, which also serve as penstocks, are built in the dam near one shore in the abutment, and discharge through draught tubes which extend under the floor of an extension of the dam. The turbines are controlled by Lombard oil-pressure governors, which are actuated from the shaft of the wheels. The governors are fitted with small motors, which permit of controlling the speed of the turbines directly from the switchboard. In addition there is a small McCormick turbine which is belted to an exciter and controlled by a Woodward governor. The centre of all the wheels is about twenty-five feet above tail-water.

The generators, which are directly connected to the turbines by means of a flange coupling, are three in number and are of Westinghouse make. They are of the revolving armature type each of 550 kilowatts' output with thirty-two poles, and at their normal speed of 225 revolutions generate two-phase current at 440 volts pressure and 625 amperes per phase. In the near future four more generators of the same output, voltage and amperage will be installed. The generators will be excited by two dynamos, each of fifty-six kilowatts' capacity, which rotate at a speed of 525 revolutions per minute and generate current at 125 volts.

The current from the main generators is conducted to the switchboard, which is located on the floor of the power-house, through terra-cotta ducts. The switchboard and its complement of instruments embody the usual practice in hydroelectric plants of this output. The board and its equipment are of Westinghouse make and comprise separate generator and feeder panels and an exciter panel. The only noteworthy feature in the equipment is the use of air-break switches, which, however, only have to handle current at 440 volts pressure.

The 440-volt current is thence led to two raising transformers which are installed in a brick house just above the power-house. These transformers raise the pressure to 50,000 volts for transmission and also transform it from two to three phase by the Scott method. The transformers are of the oil-insulated, water-cooled type.

A switch house is located a short distance above the transformer house and contains the high-tension oil-switches and the lightning arresters. The arresters are General Electric multiplex type. The high-tension lines leave the transformer and switch houses through circular porcelain bushings, the circuits consisting of No. 1 hard-drawn copper wire. The transmission lines are carried on steel towers spaced 510 feet apart, there being eleven towers to the mile. The circuit is



TRANSMISSION LINE, NORTH GEORGIA ELECTRIC COMPANY.

arranged in the form of an equilateral triangle, with a spacing of thirty-six inches between wires. The steel towers are of the usual windmill tower form, but are worthy of note in that they are built of iron piping and assembled in the field. They are painted and are supported in the ground by placing the four legs of a tower in holes and tamping the earth around them. The single three-phase transmission circuit follows an air-line to Gainesville, a few miles distant, where a few hundred horse-power are utilized by small manufacturing industries and a street railway property.

The bulk of the power is to be transmitted to Atlanta, fifty miles distant, and at this writing the steel tower line has been nearly completed. The entire transmission line is built over a private right of way, twenty-five feet in width, and it is the intention to construct an interurban electric railway line between Gainesville and Atlanta, paralleling the transmission line.

The conception, organization and consummation of this hydroelectric power development which, when completed, will be the longest power transmission in the South, is due to the untiring energy of General A. J. Warner, ex-representative in Congress from Ohio, who is president of the North Georgia company. The design of the entire development is due to W. A. Carlisle, chief engineer, who also superintended the work of construction, being assisted by F. P. Catchings, electrical engineer.

General Electric Stock Issue.

The General Electric directors have voted to increase the capital stock by $20,000,000, making the total amount $80,000,000.

Of this amount $11,000,000 will be offered to stockholders at par. Holders of five shares of the old stock are entitled to one share of the new stock to be issued.

The new stock of the General Electric Company will be used for extensions and increasing the working capital of the corporation. The company will expend next year between $5,000,000 and $6,000,000 for extensions.

Extensions already under way, and which are being met from the proceeds of the stock authorized last year, will give the company an additional floor space of about 1,150,000 square feet, making a total of 5,500,000 square feet. A special meeting of the stockholders will be called on November 20 to authorize the increase in stock proposed by the directors.

Based on the present selling price, 181, the rights are worth $13.50 per share. The issuance of about $11,000,000 additional stock by the company, conferring rights upon stockholders estimated at $13.50, makes a total of $28 in rights which stockholders have received during the past three years, equal to $9 per share yearly, and making the total return per share, including dividends, over $17 yearly for the last three years.

Electrical Notes from Europe.

(By Our Special Correspondent.)

A HYDROELECTRIC plant has been recently installed near the town of Rienz, in the Tyrol, in order to secure a large supply of current for lighting and motors in this locality. A dam has been built across the river Rienz and from this point the water is taken by canal 4,000 feet in length to a large settling basin. Three penstocks lead from the basin to the turbine house. The length of the penstocks is 180 feet, with a four-foot diameter. At present there are three turbines installed in the Rienz plant. They are of the Francis type and are designed to give 700 horse-power each. To the turbines are connected alternators which deliver a current of 5,000 volts at fifty cycles, and each of the machines carries an exciter on the end of the shaft. At present an extensive system of feeders runs from the station through the surrounding region and it supplies current for a great number of localities, including the town of Rienz, which takes most of the current. For the public and private lighting the voltage is lowered to 150 by transformers.

A somewhat unusual piece of metallic construction is now being carried out for the Metropolitan underground line in Paris, upon the new section which runs in the tunnel from the Clignancourt to the Orleans gates. It follows a general north and south direction across the city. Where the line crosses the Seine the tunnel construction is formed of a series of caissons which are sunk to a considerable depth below the river bed, where the metallic structure is laid upon the solid rock. The interior of the caisson follows the standard tunnel section of the road for the double track line. Several sections of the cai have already been sunk in the river bed, and this work is now being carried on. Of a much larger size and more complicated construction is the caisson which is to be sunk at the Place St. Michel in order to connect with the tunnel which passes under the river and offer an intermediate portion for joining on to the regular underground line. The metallic structure is now building in a depression below the surface of the street, and when completed, it will be slowly sunk down to the proper depth. Next the river is a short tunnel section, which joins on to an immense cylindrical chamber. The latter is to be used as the underground station of the line. Then the tunnel proceeds in a metallic structure over 200 feet long. Both of the tunnel sections and the cylindrical part form a single metallic structure, and the whole presents a complicated appearance. At present the structure rises some thirty or forty feet above the street level, but when finished it will lie entirely below ground, and passengers will have access to the station by a staircase, as for the standard type of underground stations.

The Italian Government is continuing its experiments with the use of the Stassano electric furnace for the production of iron and steel. According to the most recent data relating to the 150-kilowatt type of furnace, it is operated upon three-phase current, and uses about eighty volts at the terminals. The normal charge of the furnace is 1,000 pounds of material. This is made up of cast iron mixed with lime and iron ore in the proper proportions, also a small quantity of ferro-silicon or ferro-manganese. At present the furnaces are worked for the production of steel which is used in the manufacture of projectiles, and should contain 0.4 per cent carbon, 0.03 phosphorus and 1.5 manganese. According to the most recent figures a furnace of this type will take from 1.1 to 1.3 kilowatt-hours per ton of steel. In a twenty-four-hour run, the furnace gives a yield of 2.6 tons. Three types of furnaces are now in use, having capacities of 750, 150 and 75 kilowatts respectively. As to the wear of the electrodes, this is stated to be twelve pounds per ton of steel. The refractory covering of the furnace needs to be renewed rather frequently, in general at the end of one month.

Some interesting experiments in the use of motors for farming operations have been carried on in Poland in the presence of the Prussian Minister of Agriculture. The trials of the new machines took place on the domains of Kulm, near Birnbaum, using the current from a generating plant which is mounted here. The experiments relate to the use of a new plowing machine operated on the Brutschke system and constructed by the Körting firm, of Berlin. The new plow works very rapidly, and can make three furrows at a time, of twelve inches depth. It is operated on a ten hours' run, in general, and on account of the ease of working, it has proved a favorite among the inhabitants, especially as the cost of running is low. The government committee reported in favor of the new system, and already a company has been formed for promoting it in the region. It is intended to erect a large station which will furnish current for a number of farms, and for this purpose a hydraulic plant will, no doubt, be installed, using the water of the Obra river.

The Swedish Government is taking active measures toward the operation of the state railroads on the electric system. Parliament has recently voted a credit of $1,000,000 for the purchase of a number of falls in order to erect the hydraulic plants which will be needed for supplying the current, as it is proposed to operate the roads entirely by hydraulic power. At present the government has already acquired a number of falls, among which may be mentioned the large falls of Trollhäten and Elfkarleby. The first of the hydraulic plants will be erected upon the Trollhäten fall, and Parliament has already voted the necessary amount for building the station. It is expected to secure about 75,000 horse-power available in this case, a portion of which will be utilized in the first part of the plants. As to the falls which the state controls in the northern part of the country, these will be utilized at a later period.

Among the new mountain-climbing electric roads in Switzerland is the new rack-and-pinion line which runs from Brunnen, on the Four Cantons lake, to the town of Morschach, which lies at 650 feet altitude. The road is laid in narrow-gauge, upon steel ties, and contains many short curves and steep grades. The train is made up of a locomotive and one or two trailers. The locomotives are constructed by the J. J. Rieter firm, of Winterthur, and are mounted on two axles, with the rack-wheel operated by a one to eleven reduction-gear. Two motors of 100 horse-power are used, and the motors work upon 750 volts, three-phase current at fifty cycles. Current is supplied to the road from a station which is located at Altdorf, with an overhead line working at 8,000 volts three-phase current. At Morschach is a transformer station containing three units which deliver 750 volts for the line. The trolley system is used upon the locomotives.

The question of inserting an amendment in the Constitution as regards hy-

draulic power has been agitated for some time past in Switzerland. Owing to the popular movement which has been going on recently, a petition containing 90,434 signatures is presented to the government, favoring the insertion of the amendment. The text of the latter is as follows: Article 23, *viz.*, The legislation as to the use of hydraulic power belongs to the Confederation. Nevertheless, the cantons or other authorities designated by the cantonal legislation are exclusively to collect the taxes and other impositions coming from the use of hydraulic power. Following the promulgation of the present article, new concessions will be granted only under reserve of the dispositions taken by the future Federal legislation, and the energy produced by the hydraulic forces can not be transported to foreign countries except by authorization of the Federal Council.

It appears that the long-discussed project of a direct electric railroad from Rome to Naples is now to be definitely executed, provided the Italian Government decides to award the concession for such a line which has been asked for by a leading banking house. This firm has a large capital, and is prepared to execute the project within a reasonable time. The project has been drawn up by the engineer Pivetti. Current for the new road can be secured from different branches of the Voltumo river. It is proposed to award the concession for the line for a period of years, after which the Italian Government will continue to operate it. No subsidy is asked from the state by the projectors of the road, which is a favorable point. The subsequent transfer to the government is to be done without any expense to the latter. As to the operation of the line, it is proposed to run extra-fast through express trains between the two cities, a distance of 122 miles, as well as ordinary express trains and slower trains. The high-speed trains are to cover the distance in one hour and forty minutes. The new road is to be used entirely for passenger trains, and no freight trains will be run upon it.

The Perelli Company has recently brought out a new form of cable for 100,000 volts which is said to hold out very well. It is stated that a section of it was tested to 300,000 volts, and a long portion of cable at 150,000 volts, without showing any defects. A new principle is applied in the construction of the cable, based on a series of concentric layers of insulation having different specific inductive capacities. To carry this out, the stranded copper cable forming the core is first given a coating of lead, so as to provide a smooth surface and give a large diameter. On this is placed the series of layers of insulation. The specific inductive capacity of the material decreases at each layer, going from the centre to the outside. To build up the cable a core is first taken, composed of nineteen copper wires of 3.3-millimeter gauge and having a total section of 162 square millimeters. A lead tube is run over the core having eighteen millimeters outer diameter. On this is placed a layer of rubber insulation 2.5 millimeters thick, whose specific inductive capacity equals 6.1. The second and third layers of insulation have respectively 2.3 and 4.5 millimeters thickness with inductive capacities of 4.7 and 4.2. A 5.2-millimeter layer of treated paper comes over this, with a specific inductive capacity of 4.0. A protecting coat and a lead outer covering completes the cable, which has 14.5 millimeters total thickness of insulation.

According to the terms of the contract passed between the Swiss Government railroads and the Brown-Boveri Company for operating the electric trains on the Simplon Tunnel line, the trains are to be run under the following conditions over the three-phase line. During the passage of the trains from Brigue to Iselle, the electric locomotives are to draw the passenger trains at forty-five miles an hour, and the freight trains at twenty-one miles an hour. When passing the opposite way, the passenger trains will run at only twenty-one miles an hour as far as the station of the tunnel, and from thence to Brigue at forty-five miles an hour. During the passage of the trains over the whole of the line there shall be sufficient current so that a passenger and a freight train can cross in the tunnel and also that the two locomotives can be started at the same time. At the north and south ends of the tunnel are located two separate electric stations for the road, each containing an alternator with its exciter and switchboard. As regards the wiring in the tunnel, the contract stipulates that it shall be laid out so that the line can be run at a later date upon the single-phase system, should it be thought advisable to do so.

C. L. DURAND.

Paris, September 29.

Combination of Independent Telephone Companies.

A dispatch from Pittsburg, Pa., states that a telephone merger has been perfected by the "American Union Telephone Company." One hundred companies, with 40,000 telephones and ten long-distance lines, are combined and capitalized at $25,000,000. Pennsylvania, New York, Ohio, Maryland, Virginia and West Virginia are affected by the consolidation.

SOUND ENGINEERING IN INTERURBAN RAILWAY CONSTRUCTION.[1]

BY GUY MORRISON WALKER.

In the construction of railways there is a constant conflict between two diametrically opposing views. First, there is the view of the engineer whose scientific and technical education leads him to plan and urge the best that money can buy or produce; regarding the proposition as an opportunity to show his engineering skill. He struggles for long tangents, low grades, heavy bridges, wide cuts and fills, and a surplus of motive power, constantly holding up to view the desirability of securing economy of operation and low cost of maintenance. On the other hand stands the promoter or broker, who, ignoring all these physical problems, tries to see how much paper in the shape of bonds and stocks he can issue and float against the least possible real property.

Now, the fact is that neither point of view is the correct one, but that somewhere between these two extremes lies the true economic means of a road good enough to carry the traffic and business in its territory, with enough stocks and bonds issued against it to recoup the bankers and investors for their outlay.

The first engineers on interurban railways came from the city lines, and with their city experience they imposed upon these interurban roads city construction and supplied them with city power, as if for city traffic, burdening them not only with a heavy fixed charge to cover the abnormal capital expenditure, but with the expense of a general organization like that on city lines. It was only the fact that these interurban roads were built in thickly populated communities that enabled most of them to carry this burden and survive the management that they endured. Few of them proved profitable until, as years rolled on, the farms through which they ran were cut up into small plots, the communities filled up with new population, and the traffic developed to the point where it was able to absorb this early waste.

When interurban railways first began to be built, there were many places where the population was already so dense and well distributed as to furnish the traffic necessary to make such roads pay, but the ten short years that have elapsed since interurban electric railways were first proved to be successful, have sufficed to see almost every locality with traffic and population enough to support an interurban railway,

[1] Abstracted from an address delivered before the students of Sibley College, Cornell University, Ithaca, N. Y.

already supplied with such a service. Indeed, reckless promoters and ignorant investors have built many such lines in communities not yet sufficiently developed to support them, and now find that they have an investment which not only yields them no income, but that the traffic in many instances does not yield enough to pay even operating expenses, and so they are threatened with the loss of their principal, and the fault in many of these cases has been due to the short-sightedness and stupidity of the engineers in charge of the construction.

There is a strong disposition on the part of most engineers to spend on the construction of a road all the money that they can get their backers or clients to put up. Even at the present time the most serious handicap upon existing roads and the most serious obstacle to the further development of interurban railways is the heavy construction advised by most engineers and the heavy equipment almost universally recommended by manufacturers.

The promoters and owners of these properties have not generally taken the public into their confidence, and so it is only those who are on the inside and to whom come the frequent appeals for financial assistance, who know the old, old story of elaborate construction, built at tremendous cost, and heavy equipment run at enormous expense, in advance of the development of traffic. Many of these roads have struggled along borrowing the money with which to pay fixed charges and striving to keep out of the hands of the receiver for a year or two longer, in the hope that by that time the traffic will have developed enough to enable them to pay their way.

It is impossible to estimate how much the development of interurban railways has been retarded by these false standards of physical perfection, and the time has come when the interest and rights of bankers and investors whose capital has been tied up in unremunerative projects, are entitled to paramount consideration, and I wish to impress upon you that, as engineers, you have no more right to experiment at the expense of your clients in an undertaking which they expect to be remunerative, than has a physician to take liberties with the body of his patient.

Select equipment that you know will do the work. Be neither the first to adopt a new device, nor the last to abandon an old. It is your duty as engineers to consider first the economic feature of the enterprises submitted to you for your decision or direction. It has been said that there are no physical difficulties with which engineering skill can not successfully cope. It is merely a question of money. Practically speaking, this is true, and you will find early in your careers that the real question that you have to answer will not be "can it be done," or "how shall it be done," but a really far more important question as to whether the results to be secured will warrant the cost. You should strive to make money for your clients, for by so doing you will not only secure a satisfied clientage, but by building for them profitable and paying plants you will place it within their power to proceed with the building and development of other properties, and so add to the prosperity of the community while making business for yourselves. On the other hand, if you tie up the capital of your client in an unprofitable proposition, you are guilty of an economic crime against the community in which the non-paying investment is made, and you commit a wrong against the man whose further activities you have prevented by placing his capital where he is unable to realize upon it, in addition to losing a client and destroying business for yourselves. A large fee will be cheerfully paid from a successful enterprise out of the operation of which all the stockholders are profiting while a pittance will be paid grudgingly out of a wreck.

And so, instead of the old standards that have so long prevailed, I desire to raise a new and practical standard which recognizes not only the rights of the investor, but the economic good of the community in which the investment is made, and so I say to you, "Build not the best, but build the best that will pay."

It is plain that railroads built according to the standards of construction that prevail in communities thickly populated and with a heavy traffic already developed, will not pay for years to come in these thinner populated regions, and because the engineer has not yet been found to construct a road as cheaply as it must needs be constructed for it to pay in such localities. And so further development of interurban railways has largely come to be a question as to whether or not a locality must do without local service because a road costing $40,000 a mile will not pay in that territory, or because it can not support a road costing, say, over $20,000 per mile.

In considering a new proposition you should first determine what investment the territory will support. Be assured that the necessary capital is in sight and then plan a completed and earning plant to come within the limits of the proposed investment. It is one of the most common complaints against engineers that the completion of their plans usually costs fifty per cent more than their estimates. As a rule there is nothing so worthless as the "engineers' reports," which the promoters lay before bankers and financiers, unless it be the franchises of which they talk so glibly and for which they claim to have expended such large sums. After the surveys necessary to locate the line, which should not cost much, the first expenditure of money should be for the securing of all the right of way that can be secured without condemnation proceedings, and then suit should be at once instituted against these. The reason for this is, that if an enterprise has any merit in it whatever, its success is assured from the time that it owns a continuous strip of right of way between the proposed terminals, while if it has no merit there is no expenditure that involves less loss, for the fact is that the importance of transportation is so great that there are few real estate holdings that appreciate in value as do these comparatively worthless small tracts when strung together in a continuous line from city to city.

The right of way secured, the next money expended should be for grading. There are two or three good reasons for advising this as the second step. The first is, that there is nothing in connection with railroad work on which you can make a larger and better showing with such a small expenditure of money than you can in the matter of grading. Then, too, it satisfies your client, for he is able to see results; it satisfies the community, for they realize that work is being done and that a railroad is being built, and nothing goes further than this in establishing credit for the new enterprise; while, most important of all, the possession of a graded right of way is the best insurance of your client against competition or loss, for even if his funds should fail him at this point, it is more than likely that he will be able to turn such an asset into some new company for a profit.

Having gotten thus far, the next step is the purchase of ties and rails, and then, with the least expenditure possible on any other account, hurry the laying of track until you can show a continuous pair of rails between your terminals. So many engineers make the mistake of practically completing their track as they go, expending as much in the completion of ten miles, which leads them only half way to the objective point, as would be necessary to reach the objective point if the

wiser course had been pursued. The ten miles of track would take you nowhere, but you can ride over the twenty miles from one town to the next even though the going may be rough and slow.

Up to this point you will have been producing real property with the least possible waste. The difference between the sixty-pound and eighty-pound rail will enable you to save twenty-five per cent on the investment in steel, and I might say that one of the best interurban roads of which I have any knowledge has been running its cars for nearly twelve years over fifty-pound rail that is still without sign of wear or deterioration.

Whatever you use, rail and ties should be the best in quality, for there are no profitable economies in the manner of permanent way, but from this point on you should carefully determine the best that the immediate traffic will support with the least probable loss on account of future replacements, and it will not do to discount the future too much. So many engineers burden a small proposition by attempting to build along with the first mileage a power plant large enough not only for the original proposition, but for all its probable extensions. Now, it is mileage that earns the money, and to burden a small proposition with the capital charge of a heavy power-house for which it has no use, simply means to break it financially.

The proper plan is to instal units, second hand, if possible, no larger than the existing mileage needs for its operation, installing additional units as fast as its growth and extension may make necessary, until the territory has been reasonably covered, and the traffic developed to the point where the mileage can properly use and the earnings carry the cost of a suitable power-house, for when this time comes, the original units are not loss, but may be reinstalled in other places to carry other plants through a similar period of development. There is no other initial economy that pays as this does, for it is rarely possible to anticipate the power demands of a territory, and great loss has frequently been incurred by attempting to do so.

One of the most foolish extravagances is the building of a double-track road where a single track will carry all the traffic that can be developed for years to come, for, with your right of way and grade, it is a simple matter to supply the second track when the traffic becomes too heavy for the first. So, if you really must have fifty miles of track, and the distance is only twenty-five miles, find some other place to build the other twenty-five miles, for it is far better to have two single-track roads paying big dividends than a fine double-track proposition that does not earn its fixed charges.

Probably more important even than the question of power is the question of cars and equipment. Cars of from sixty to seventy feet in length, equipped with four motors of from seventy-five to 100 horse-power each, look very handsome and start up quickly from zero, but they cost about $10,000 apiece, and the amount of power that it takes to move the mere weight of the car is a matter that deserves consideration. One of the best paying properties that I know has for years used a car with fifty-six seats, measuring forty-two feet over all, equipped with only two thirty-five-horse-power motors. These cars are built with firm steel frames, yet are extremely light, and have cost complete but little over $4,000 apiece, yet they take in just as much money as any of the large cars.

It is in this matter of traffic that engineers are more often astray than in anything else, for their desire to make new business too frequently induces them to make estimates not only unsupported by any experience, but in many cases beyond all reason. A recent very glaring instance of this kind has come to my attention where a distinguished firm of engineers, in order to justify the expenditure made necessary by some very heavy construction, and a large amount of difficult bridging, estimated the traffic on a fifty-mile road between two large cities at a higher amount per mile than the street railway mileage in those cities had ever taken in, while the fact was that the gross earnings of the road would hardly have been sufficient to pay the fixed charges on its proposed cost.

Two interurban roads running out of Cleveland, Ohio, have forty and forty-four miles of track, respectively. The forty-mile road serves about 440,000 people, while the forty-four-mile road serves about 420,000 people, or only 20,000 less than the first road. With a population so nearly the same the engineers had estimated that the traffic of the second road would be approximately the same as that of the first, but after several years of operation the traffic receipts of the shorter road are still twice as large as those of the longer road, which has now been in the hands of a receiver for several years. The reason for this difference in earnings was, however, understood when upon investigation it was found that 400,000 of the population estimated to be served by each road was in the city of Cleveland itself, while the population served outside of Cleveland was 40,000 in one case and only 20,000 in the other, and that these proportions bear the same proportion to each other as do the earnings of the respective roads that serve them.

In estimating the traffic from a proposed interurban road, you will find it unsafe to consider the population of your larger terminus. This larger terminus is extremely necessary for the success of such a road, for you must have some place to which the people along the line desire to go, but you will find that the people of the larger cities have little business and no inclination to leave their large city and ride out to the smaller points along the line, so you must begin by ignoring the population in the large city. You will also find that the much-talked-of farmer traffic is so small as to be almost a negligible quantity. The riding population, which must be the source of your earnings, you will find to be the population of the villages and towns that you reach, who seek the large terminal for business or pleasure.

For the proper support of an interurban railroad this urban population, outside of the large terminus, should not be less than 750 per mile, and you will find that such a population will yield about five dollars per capita. Such a population will support an electric railway as ordinarily built, paying ordinary fixed charges on a bonded debt, large enough to cover the cost of its construction, but without profit to the promoters or stockholders. In order to be profitable, such a line should have an interurban population, outside of the larger terminus, of at least ten hundred per mile of track. Should this population, however, be less than 750 per mile of track, the proposition is likely to prove a financial failure unless built with extraordinary economy.

It is hard to discuss the cost of construction of interurban roads, because so few of them are built with real money. There is so much waste in the methods of the ordinary promoter, and his ways of raising capital are not only expensive, but his lack of credit makes the carrying charges during the period of construction extremely high. If built and paid for with real money these roads should vary in cost from $16,000 to $25,000 per mile, according to cost of right of way, weight of rail, and power and equipment used. In no case should they exceed this higher sum unless there exists in the particular place some physical difficulties, such as a large amount of tunneling, rock cuts, or heavy bridging.

On the other hand, I have known one or two very profitable propositions doing good service in small communities that have been built for less than $15,000 per mile, these sums including in all cases the cost of power-house and equipment.

American Street and Interurban Railway Association.

Auspicious Opening of the Annual Convention at Columbus.

(Special Telegram to the Electrical Review.)

COLUMBUS, OHIO, OCTOBER 16.—The opening of the annual convention and exhibition of the American Street and Interurban Railway Association was particularly auspicious, the weather conditions being perfect and the attendance reaching well above 2,500 railway men, manufacturers and supply men. Among those long affiliated with the association who were present were Harvey M. Littel, Hon. W. Caryl Ely, E. F. Peck, J. S. Doyle, Paul Winsor, W. B. Potter, Charles Remelius, H. H. Adams, S. L. Rhodes, John R. Graham, John J. Lane, Fred G. Simmons, John I. Beggs and Fred N. Bushnell.

The first session of the convention, that of the American Street and Interurban Railway Engineering Association, was called to order by the president, H. H. Adams, of Baltimore, Md., Monday morning at 11 o'clock. Mr. Adams introduced E. C. Spring, president of the Central Electric Railway Association, who delivered an address of welcome to Columbus. He was followed by James H. McGraw who, as president, addressed the meeting on behalf of the Manufacturers' Association. John I. Beggs also addressed the meeting briefly. Then followed the reading of the president's address and the reports of the executive committee and the secretary and treasurer. After the appointment of a committee on resolutions the meeting adjourned.

The afternoon session was called at 2.10 o'clock, when the Hon. W. Caryl Ely addressed the meeting. He said that the engineering association was one of the most important of the re-organization, appealing most strongly to the largest number of members of the association and made a strong plea for earnest, concentrated work, so that the benefits derived might be permanent.

The report of committee on control apparatus was presented by J. S. Doyle, chairman, and discussed by G. J. Smith, Kansas City; E. W. Olds, Milwaukee; H. H. Adams, F. E. Case, Schenectady; W. H. McAloney, Denver; Paul Winsor, Boston; N. W. Storer and William Cooper, Pittsburg.

A paper entitled "Ties, Poles and Posts," was presented by C. A. Alderman, Cincinnati, and discussed by A. S. Richey, Worcester; F. G. Simmons, G. F. Smith, E. J. Dunn and others.

This paper discusses the increasing cost of wood ties, which is leading to the use of other materials. Specifications for ties in use on certain railroads in the West are quoted, and directions are given for the making of concrete ties, poles and posts. To explain the scarcity of tie timber in the United States it is shown that 82,000,000 ties are required annually for renewals alone, which is equivalent to the timber of half a million acres of forests. Steel cross-ties will be used to a considerable extent when the price for timber has advanced about twenty per cent. When inferior woods are used for ties they must be treated with a preservative, and protecting tie plates should be employed.

A paper on "Ballast," presented by Charles H. Clark, Cleveland, was discussed by N. G. Simmons, C. A. Alderman, J. M. Larned and H. B. Flemingo.

This paper is not confined to a discussion of the material used directly under the ties, but deals as well with the foundation laid for former. Methods of preparing this foundation on different characters of soils are discussed, and estimates given for the cost. The paper is illustrated with a number of photographs and diagrams showing different classes of construction, on which estimates of cost are also given.

The report of the committee on maintenance and inspection of electric equipment was also presented, and after a lengthy discussion the meeting adjourned.

The courtesies afforded by the Western Union Telegraph Company, Postal Telegraph-Cable Company, Bell Telephone Company, and Automatic Telephone Company have been greatly appreciated, and the free service given by the street railway companies has greatly facilitated traveling between hotel headquarters and the convention hall and appliance exhibition. A number of the larger companies have headquarters at the principal hotels. A feature is the lighting of the entire corridor of the Chittenden by Buckeye tantalum lamps.

The manufacturers' exhibition is remarkably complete. The exhibits are of a striking nature and for magnificence and perfect setting far surpass anything heretofore attempted. The large displays of Westinghouse, General Electric, Electric Service Supplies, Electric Storage Battery, Lorain Steel, Carnegie Steel, John A. Roebling's Sons, H. W. Johns-Manville, Allis-Chalmers, National Brake and Electric, Chicago Pneumatic Tool, and Franklin Electric Manufacturing companies, all show apparatus under actual service conditions and attract constant attention. In addition to exhibits in the six buildings, covering 110,000 square feet, there is a splendid showing of high-speed interurban steel and wooden cars on side tracks of the "Big Four" railroad, adjacent to exhibit buildings.

Among the manufacturers the following were present on the opening days: Edwin M. Hamlin, George B. Crane, R. H. Watson, William M. Lawler, Claude M. Matthews, J. R. Kearney, B. S. Klees, G. O. Curtis, F. E. Wilson, E. R. Bliss, F. M. Evans, John C. Dolph, C. N. Leet, Frank C. Randall, Dwight Dean, G. M. Haskell, C. H. Spotts, W. M. W. Easton, W. E. Harrington, Charles C. Pierce, J. V. E. Titus, Max Berg, C. H. Bristol, J. N. Porter, Charles J. Mayer, James Todd, Daniel N. Brady, E. J. Wendell, Joseph R. Ellicott, F. B. Degrass, Julian Roe, Josh Cunningham, W. W. Powers, W. H. Hawlings, Jr., J. W. Perry, B. M. Barr, J. C. McQuiston, J. H. Denton, John H. Thomas, F. V. Green, F. H. Gale, Thomas Bibber, W. S. Hager, James G. Biddle, Walter Chur, F. A. Keys, A. O. Benecke, A. H. Whiteside, C. A. Tupper, C. L. Knight, B. B. Ayers, E. J. Blake, C. C. Blake, Harold P. Brown, C. H. Weeks, V. T. Price, H. Lee Bragg, F. D. Masterson, J. W. Duntley, W. O. Duntley, C. B. Coates, A. W. Lenderoth, T. J. Creaghead, F. F. Skeel, C. M. Crofoot, Robert F. Carr, E. A. Dossert, Charles Blizard, G. H. Atkin, H. A. Gay, W. S. Sisson, C. E. Harmon, W. R. Gaston, Charles Ewing, W. J. Clark, H. N. Ransome, W. G. Carey, John E. Ward, Charles K. Knickerbocker, F. P. Harrison, J. W. Perry, A. D. Newton, E. C. Green, A. E. Ducklose, L. O. Dudas, A. T. Baldwin, Charles C. Pierce, G. H. Miller, L. T. Wailes, W. H. Goble, W. R. Crawford, T. J. Cunningham, J. E. Perry, Bert Aikman, C. K. King, U. M. Garland, R. M. Campbell, E. G. Condit, D. J. Evans, J. S. Speer, G. P. Fryling, E. M. Williams, W. W. Affleck, W. P. Bowman, H. L. Shippy, H. W. Benedict, H. H. Cowherd, J. B. Thomas, L. Robinson, F. A. Elinguist, C. L. Cool, S. C. Schenck, A. S.

King, E. G. Chamberlin, C. W. Beaver, H. E. Dickerman, W. C. Guest, A. S. Howlett, F. D. Killion, J. A. Brett, L. M. Cargo, W. L. Conwell, R. W. Beebe, C. S. Cook, C. F. Medbury, John B. Allen, F. S. Smith, F. F. Roher.

The following companies are represented in the manufacturers' exhibit:

Allis-Chalmers Company, Milwaukee, Wis.

American Brake-Shoe and Foundry Company, Mahwah, N. J.

American Instrument Company, Philadelphia, Pa.

American Railway Supply Company, New York, N. Y.

A. & J. M. Anderson Manufacturing Company, Boston, Mass.

Armstrong Oiler Company, Philadelphia, Pa.

Atlas Railway Supply Company, Chicago, Ill.

American Mason Safety Tread Company, Boston, Mass.

American Steel and Wire Company, Chicago, Ill.

Atha Steel Castings Company, Newark, N. J.

Adams & Westlake Company, Chicago, Ill.

Acme Automatic Street Indicator Company.

Bayonet Trolley Harp Company, Springfield, Ohio.

Blake Signal and Manufacturing Company, Boston, Mass.

J. G. Brill Company, Philadelphia, Pa.

Harold P. Brown, New York, N. Y.

Buckeye Engine Company, Salem, Ohio.

Burnham, Williams & Company, Philadelphia, Pa.

Brady Brass Company, New York, N. Y.

S. F. Bowser & Company, South Bend, Ind.

L. M. Booth Company.

Cleveland Frog and Crossing Company, Cleveland, Ohio.

Consolidated Car Fender Company, Providence, R. I.

Consolidated Car Heating Company, New York, N. Y.

Cook's Railway Appliance Company, Kalamazoo, Mich.

Curtain Supply Company, Chicago, Ill.

Creaghead Engineering Company, Cincinnati, Ohio.

Cambria Steel Company, Philadelphia, Pa.

Dearborn Drug and Chemical Works, Chicago, Ill.

D. & W. Fuse Company, Providence, R. I.

Carnegie Steel Company, Pittsburg, Pa.

Duff Manufacturing Company, Pittsburg, Pa.

Dayton Manufacturing Company, Dayton, Ohio.

Joseph Dixon Crucible Company, Jersey City, N. J.

Duplicate Transfer and Rebate Company, Philadelphia, Pa.

DuQuesne Steel Foundry Company, Pittsburg, Pa.

Dossert & Company, New York, N. Y.

Dressel Railway Lamp Works, New York, N. Y.

O. M. Edwards Company, Syracuse, N. Y.

Electric Railway Equipment Company, Cincinnati, Ohio.

Electric Storage Battery Company, Philadelphia, Pa.

Charles I. Earll, New York, N. Y.

Electrical Review, New York, N. Y.

Electric Service Supplies Company, Chicago, Ill.

Eclipse Railway Supply Company, Cleveland, Ohio.

Franklin Car Heating Company, Syracuse, N. Y.

Franklin Electric Manufacturing Company, Hartford, Ct.

Felt & Tarrant Manufacturing Company, Chicago, Ill.

Galena Signal Oil Company, Franklin, Pa.

W. R. Garton Company, Chicago, Ill.

General Electric Company, Schenectady, N. Y.

Gold Car Heating and Lighting Company, New York, N. Y.

Goldschmidt Thermit Company, New York, N. Y.

Globe Ticket Company, Philadelphia, Pa.

Griffin Wheel Company, Chicago, Ill.

General Systems Company, Dayton, Ohio.

Hale & Kilburn Manufacturing Company, Philadelphia, Pa.

F. P. Harrison Electric and Manufacturing Company, Incorporated, New York.

Albert B. Herrick, Ridgewood, N. J.

Heywood Bros. & Wakefield Company, Wakefield, Mass.

George S. Hastings & Company, Cleveland, Ohio.

Helios Manufacturing Company, New York, N. Y.

Indianapolis Switch and Frog Company, Indianapolis, Ind.

Ingersoll Company, Pittsburg, Pa.

International Register Company, Chicago, Ill.

International Sprinkler Company, Philadelphia, Pa.

H. W. Johns-Manville Company, New York, N. Y.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.

Kinnear Manufacturing Company, Columbus, Ohio.

Keystone Brake-Shoe Company, New York, N. Y.

George W. Lord Company, Philadelphia, Pa.

Lagonda Manufacturing Company, Springfield, Ohio.

Lorain Steel Company, Philadelphia, Pa.

Lord Electric Company, Boston, Mass.

Lumen Bearing Company, Buffalo, N. Y.

Massachusetts Chemical Company, Walpole, Mass.

John W. Masury & Son, Brooklyn, N. Y.

Maryland Steel Company, Sparrow's Point, Md.

Miller Anchor Company, Norwalk, Ohio.

McGuire-Cummings Manufacturing Company, Chicago, Ill.

National Brake Company, Buffalo, N. Y.

National Brake and Electric Company, Milwaukee, Wis.

National Lock Washer Company, Newark, N. J.

Niles Car and Manufacturing Company, Niles, Ohio.

R. D. Nuttall Company, Pittsburg, Pa.

National Car Wheel Company, Pittsburg, Pa.

Ohio Brass Company, Mansfield, Ohio.

Ohmer Fare Register Company, Dayton, Ohio.

Pantasote Company, New York, N. Y.

Pressed Steel Car Company, Pittsburg, Pa.

Pennsylvania Steel Company, Philadelphia, Pa.

Pittsburg Insulating Company, Pittsburg, Pa.

Quincy, Manchester, Sargent Company, Chicago, Ill.

Rail Joint Company, New York, N. Y.

Recording Fare Register Company, New Haven, Ct.

Joseph T. Ryerson & Son, Chicago, Ill.

Frank Ridlon Company, Boston, Mass.

Sherwin-Williams Company, Cleveland, Ohio.

Southern Exchange Company, New York, N. Y.

Speer Carbon Company, St. Marys, Pa.

Standard Paint Company, New York, N. Y.

Standard Steel Works, Philadelphia, Pa.

Peter Smith Heater Company, Detroit, Mich.

Security Register and Manufacturing Company, New York, N. Y.

Standard Varnish Works, New York, N. Y.

Sterling Varnish Company, Pittsburg, Pa.

Star Brass Works, Kalamazoo, Mich.

The T. H. Symington Company, Baltimore, Md.

Schoen Steel Wheel Company, Philadelphia, Pa.

St. Louis Car Company, St. Louis, Mo.

St. Louis Car Wheel Company, St. Louis Mo.

Sterling-Meaker Company, Newark, N. J.

Taylor Electric Truck Company, Troy, N. Y.

Trolley Supply Company, Canton, Ohio.

United States Metal and Manufacturing Company, New York, N. Y.

United States Engineering Company.

W. T. Van Dorn Company, Chicago, Ill.

Van Dorn & Dutton Company, Cleveland, Ohio.

Wallace Supply Company, Chicago, Ill.

Western Electric Company, Chicago, Ill.

Westinghouse Companies, Pittsburg, Pa.

William Wharton, Jr., & Company, Philadelphia, Pa.

Wheel Truing Brake-Shoe Company, Detroit, Mich.

Wilson Company, Chicago, Ill.

Yale & Towne Manufacturing Company, New York, N. Y.

On Monday evening an assembly meeting and reunion was held at the Southern Hotel. The programme for Tuesday evening includes a reception and dance at Memorial Building. For Wednesday evening the entire seating capacity of the Shubert Theatre, where "Fantana" is being played, has been engaged, and also that of the Southern Theatre, where "She Stoops to Conquer" will be seen. On Thursday afternoon there will be a song recital and tea at the Arlington Country Club, and on Thursday evening the annual banquet will be held. On Friday evening there will be the annual amateur vaudeville show at the Southern Theatre.

A. A. G.

Committee on Public Policy of the National Electric Light Association.

The committee on public policy of the National Electric Light Association held a meeting at the Waldorf-Astoria, New York city, on Thursday, October 11. This committee is one of the most important of the association. It consists of Everett W. Burdett, chairman; Henry L. Doherty, Charles L. Edgar, Samuel Insull, J. W. Lieb, Jr., Joseph P. McCall, Alex Dow and Samuel Scovil. W. H. Gardiner, Jr., has been appointed secretary of the committee.

REUNION OF THE OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION AND THE SOCIETY OF THE UNITED STATES MILITARY TELEGRAPH CORPS.

BY GEORGE C. MAYNARD.

The twenty-sixth annual reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps was held at the Arlington Hotel, in Washington, D. C., on October 9, 10 and 11.

Separate business meetings of the respective societies were held on the first day, and these were followed by a joint meeting, when business in which both organizations are mutually interested was transacted. The attendance was large and the proceedings of much interest.

The societies were welcomed to the national capital by the president of the Board of Commissioners of the District of Columbia, H. B. F. Macfarland. In his address Mr. Macfarland referred to the fact that Washington was the place where the telegraph business was first started; that many notable events connected with the enterprise occurred here, and that this was the place where telegraphers should always receive a cordial welcome and consider themselves as at home.

A response to this welcoming address was made by William J. Dealy, of New York city, in his customary eloquent and appropriate manner.

In opening the meeting of the Old Timers, the president, William H. Young, of Washington, delivered an address full of references to interesting historical events, and read a paper prepared by Dr. J. J. Clark, giving an account of his work in making telegraph instruments for Professor Morse in 1844-45.

The absence of the secretary of the association, John Brant, who was unable to be present on account of severe illness, was much regretted, and a temporary secretary was designated to make a record of the proceedings. After the reports of officers were presented and other routine business was transacted, the following officers were elected for the ensuing year: president, Harvey D. Reynolds, Buffalo; vice-presidents, George A. Burnett, Buffalo, George F. Macdonald, Ottawa, Canada, I. McMichael, Toronto, Canada; secretary and treasurer, John Brant, New York city.

President William B. Wilson, of the Military Telegraphers, called the meeting of that society to order, delivered a stirring address containing an account of the doings of the society during the past year, and made an earnest plea for greater earnestness and activity on the part of the members in their endeavor to secure congressional action, which will give to the members of the organization the right to apply for pensions, and place them on an equal footing with the soldiers of the army in this respect.

The election of officers resulted as follows: president, William B. Wilson, Holmesburg, Pa.; vice-president, William L. Ives, New York; secretary and treasurer, James E. Pettit, Chicago.

At the joint meeting numerous letters and telegrams from members unable to be present were read, and the following communication was sent to them and placed on the records: "The Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps, assembled in their twenty-sixth annual reunion at Washington, D. C., send cordial, fraternal greetings to all absent members, with best wishes for their welfare and prosperity."

The deaths during the past year were reported to the meeting as follows: Old Timers—Charles D. Livermore, Kenneth McKenzie, S. H. Kauffman, Alfred S. Brown, William A. Rudd, W. J. Byrne, Charles A. Elster, Alex M. Mackay, W. B. Clum, M. F. Gaffney, H. S. Larcombe, Rodney Smith, William F. Findley, Henry Holland, J. E. Rainsford and Theo. Sumwalt; Military Telegraphers—Martin Barth, W. S. Logue, J. D. Flynn and D. A. Williams.

The assembly stood in silence while the lists of these names were read, and the following expression of the sense of the meeting was placed on the records and sent to the families of the deceased: We give a kindly thought to our comrades who have severed their earthly circuits and answered their last call beyond the horizon of human ken, leaving some of us to linger here awhile as evening embers turn from red to gray and the dusk is waiting for the night; we recall the times which have been rendered joyous by their genial companionship and friendship; we testify to their faithfulness and usefulness in their varied walks of life; we shall always cherish their memories; to their families we tender our sincere sympathy in their bereavement.

Colonel Wilson delivered a eulogy especially referring to the memory of the late Edward Rosewater, who was one of the operators in the Civil War, and whose death occurred recently at his home in Omaha.

After the close of the business meetings

the two societies, with their friends and guests, made an excursion to Arlington in special electric cars, and the evening was spent in attending the performance at Chase's theatre.

Wednesday, the 10th, was devoted to an electric-car excursion which passed through all the most interesting sections in the city, and this was followed by an afternoon reception by President Roosevelt at the White House, where each individual received a cordial greeting. A visit to the Capitol and Congressional library followed. The library being kept open and beautifully lighted until 10 o'clock in the evening, an excellent opportunity to examine the beauties of the building was afforded. The officers of the library paid special attention to the telegraphic visitors and gave them opportunity to examine the intricate workings of the institution.

On the third day the company left the Arlington Hotel for Mount Vernon in special cars to the wharf and took the steamer down the river. Many of the guests had never visited the place before and all were intensely interested. In the afternoon visits were paid to the Corcoran Art Gallery, the National Museum, the Washington Monument and various other public institutions.

The formal exercises were closed on Thursday evening by a banquet at the Arlington Hotel, which was attended by 300 persons, one-half of whom were ladies. The Arlington's finest banquet hall was tastefully decorated with national flags, trailing vines, flowers and electric lights. A string band and a male quartette furnished music. In many of the choruses splendid voices of guests were heard. A new song dedicated to the Military Telegraphers was sung with spirit. The words of this song were written by M. H. Kerner, who also composed the music to which it was sung. The affair was elegant, harmonious and dignified. President Young was the generous host entertaining his personal friends.

P. V. DeGraw, assistant postmaster-general, acted as toastmaster and carried the proceedings through with tact and enthusiastic spirit. William J. Dealy delivered the first address in response to a toast to the ladies. His speech was appropriate, graceful and complimentary and was received with pleasure.

Professor Willis P. Moore, chief of the United States Weather Bureau, gave a brief statement of the history and operation of the service, the success of which, he declared, depends upon the excellent telegraph facilities of the United States. He stated that his bureau is conducting experiments and making plans for utilizing wireless telegraphy in collecting and distributing weather reports and expressed the opinion that it will not be long before all severe storms on the Atlantic ocean will be foretold and reported to vessels at sea.

Commander E. E. Hayden, the superintendent of the government's time service, spoke on this subject. He also acknowledged the country's indebtedness to the telegraph companies for their excellent facilities and great liberality in transmitting time signals over the world.

B. W. Trafford, general manager of the Chesapeake & Potomac Telephone Company, made one of the best addresses of the evening, briefly sketching the history of the development of the telephone business, its close relation to the telegraph, the wonderful extension of both enterprises, which demands the utmost energy and skill, and placed especial emphasis on the necessity of keeping the business on a high plane of integrity and honor.

W. W. Jermane, a prominent Washington journalist, spoke on the relations of the press and the telegraph, paying high tribute to the telegraphic fraternity for its zeal and efficiency in the prompt and rapid transmission of press despatches.

John E. Wilkie, chief of the government secret service, gave an interesting and witty talk without disclosing any secrets. He announced himself as having been a plug operator, but his speech made it clear that he knows a great deal about the business.

Colonel William B. Wilson delivered an eloquent and forcible address on the military telegraph in the Civil War. He recounted many thrilling episodes of that tragic time and paid glowing tribute to the memories of the war operators.

The closing address was by M. J. O'Leary, known as the "Irish orator" of the telegraph fraternity, whose subject was "The Telegraphers' Mutual Benefit Association as a Powerful Auxiliary for the Advancement of the Standing of the Profession." Mr. O'Leary, on behalf of the visitors, expressed thanks to the Washington members for their hospitality.

Among the invited guests at the banquet were Commissioner Macfarland; General D. J. Cragie, U. S. A.; General Dunwoody, representative of the DeForest Wireless Telegraph Company; Major A. E. H. Johnson, one of President Lincoln's private secretaries, and Dr. William Tindall, secretary to the District Commissioners.

The entire business of making and carrying out plans for the reunion was under the immediate and active control of President Young, with the cooperation and assistance of the members of the executive committee and the chairmen of the various working committees, among whom were Charles P. Adams, telegraph superintendent of the Southern Railway; G. W. Ribble, superintendent Postal Telegraph Company; James B. Yeakle, superintendent Fire Alarm Telegraph, Baltimore; P. V. DeGraw, assistant postmaster-general; Henry F. Taff, manager Western Union Telegraph Company; George C. Maynard, National Museum; Ernest W. Emery, Associated Press; Jesse H. Robinson, Weather Bureau; W. H. McKeldin, J. T. Bresnahan, R. G. Callom, P. E. Brown, J. W. Collins and J. J. Mooney, of the Western Union Telegraph Company's Washington staff. The financial affairs were ably managed by J. H. King, cashier of the Western Union office. A ladies' reception committee, under the direction of Mrs. P. V. DeGraw, cordially welcomed the guests and added much to the enjoyment of the reunion.

There was a large attendance at the meeting, including a goodly number of ladies. Among those present may be mentioned the following: William J. Dealy, J. B. Taltavall, publisher of the *Telegraph Age,* New York city; J. P. Altberger, W. T. Westbrook, Philadelphia; Charles A. Tinker, Brooklyn; W. J. Fraser, Boston; Charles Selden, J. B. Yeakle, Baltimore; I. N. Miller, Cincinnati; P. V. DeGraw, assistant postmaster-general; R. B. Dickey, Ernest W. Emery, George C. Maynard, G. W. Ribble, Washington; Henry A. Reed and wife, of Newark, N. J.; George M. Case, wife and daughter, Rochester, N. Y.; John F. Knapp, Los Angeles, Cal.; J. Annand and wife, Portland, Ore.; J. C. Smith, Dallas, Tex.; E. P. Griffith, Passaic, N. J.; R. C. Jones and wife, and G. L. Lang, Chattanooga, Tenn.; L. B. McFarlane and wife, Montreal, Canada; W. F. Williams, Portsmouth, Va.; W. P. Cline, Wilmington, N. C.

BOOK REVIEW.

"Brazing and Soldering." James F. Hobart. New York. The Derry-Collard Company. Paper. 34 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

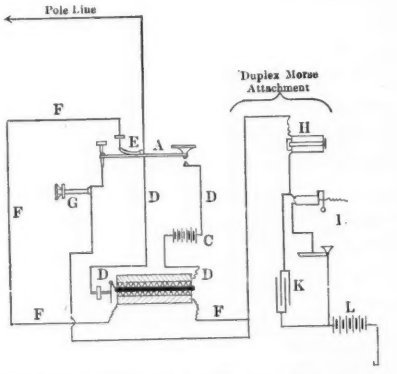
A very practical little book giving excellent instructions for brazing and soldering.

SIGNALING ON THE LEHIGH VALLEY RAILROAD.

THE OLD INDUCTION TELEGRAPH AND THE PRESENT BLOCK SYSTEM.

The success which is attending the present-day experiment of transmitting messages through space, and the assertion from time to time that application is to be made of wireless systems of communication between moving trains, calls to mind the utilization for some time of the old induction telegraph of the Consolidated Railway Telegraph Company. On Thursday, October 6, 1887, a notable assemblage of then prominent electricians, a number of them members of the old New York Electric Club, were the guests of Charles A. Cheever, president of the Consolidated company, on a trip made over the lines of the Lehigh Valley Railroad, the special feature being a test of the induction telegraph system, which the Lehigh company was making use of. The accompanying illustrations, which are reproduced from the ELECTRICAL REVIEW of Saturday, October 15, 1887, will be readily understood. The system, in brief, consisted of a single metallic conductor stretched on poles about sixteen feet above the ground, suitably connected with an apparatus for intermittently charging and discharging the line. A similar apparatus was carried upon the car, the roof of which was utilized as the condenser; or, in case the roof was not available, a rod or strip of metal was substituted. A telephone receiver was interpolated in the circuit at both receiving and sending stations, audible signals being given in place of the customary dot and dash of the visual indications of the Morse telegraph. The source of current in each case was a few cells of primary battery. The primary circuit consisted of a double-acting Morse key, a local battery and the primary of an induction coil. The secondary included a connection to the ground through the running gear and track rails, and a connection to the roof or other artificial condenser. Included in the primary circuit also was a vibrator of the now well-known buzzer type, which was utilized to throw a persistent train of electrical impulses onto the line so as to increase the inductive effect and make possible the long or short intervals of sound which would spell out the message. This system apparently worked to the perfect satisfaction of the company's guests upon this memorable occasion. Some 400 messages were sent and received in a run from Jersey City to Easton, Pa. The rapid development, however, of other forms of signaling and the complications introduced by the constantly growing traffic demands in time mitigated the usefulness of this system, and at the present time it is but a memory and an indication of the enterprise of the management of the Lehigh Valley Railroad.

The same spirit which prompted the Lehigh Valley to take advantage of the induction telegraph in 1887 is responsible for the excellent signaling system which is at present in vogue on that company's lines. The block signals on the Lehigh Valley Railroad are automatic in their action. Electricity carried through the rails in such a manner that it is controlled by the action of a pair of wheels on the track is the power that operates the signals. The road is divided into blocks varying from one-half a mile to two miles in length, the distances being determined by the density of traffic and other considerations. For example, on sections of the road where the



INDUCTION TELEGRAPH SYSTEM TRIED ON LEHIGH VALLEY RAILROAD IN 1887.

trains are most frequent the blocks are shortest. Automatic disc and semaphore signals are used. The disc signal consists of a banjo-shaped box with a large glass in the front and one in the back, the latter being painted white on the inside so that a white circular surface may be shown from the front of the signal. Inside this box is placed a red or green movable disc. This disc is either hidden, thus allowing the white glass in the back of the signal head to be seen when the signal is at safety, or exposed to view when the signal is at danger or caution. At night these signals are given by lamps placed at the back of the signal head, the light of which is thrown through a small glass opening above the large one just described. The colors—red, green and white—indicate the same conditions at night as in daytime. The semaphore signal consists of an iron post with a red arm or blade projecting at the top and a green blade with a forked end beneath. Danger or caution and safety are shown by the position of these blades. At night red, green and white lights are used in the signal indications, as in the disc signal.

At the beginning of each block is placed a signal post with a danger signal at the top and a caution signal beneath. The normal position of these signals is at danger or caution, as the case may be. A train entering a block at, say, A, causes the two signals on the post at the beginning of block B to display safety, providing there is no train or other obstruction in blocks B and C. At the same time, a danger and a caution signal are shown at the beginning of block A. As soon as the front trucks of the engine of this train pass into block B the latter also displays a caution and a danger signal. After the entire train passes out of block B the top signal at A will display safety to an approaching train, but the lower one will still be at caution. This lower signal at A will not show safety until the entire train has passed into block C—that is, the second block ahead of A. An engine-man then has an indication of the presence of a train on the same track two blocks ahead of his train, and a double indication—that is, a danger and a caution signal—at the beginning of the block in which the train is located.

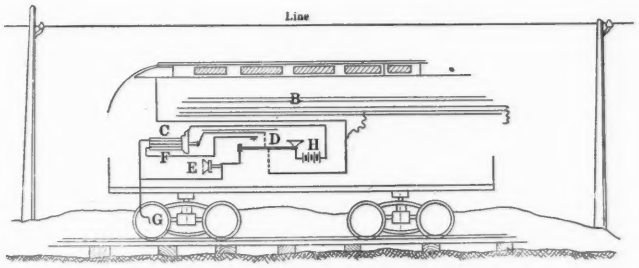
These signals do not merely give indications of a train ahead. Should a rail be broken, a switch open or any other impediment which would interfere with the safe passage of the train be in a block, the signals in the rear will display danger and caution, the same as if the train were on the rails at that point.

Another important feature of this system is the system of switch indicators. This consists of a small disc placed in an iron box about five feet above the ground in close proximity to each switch leading out of the main tracks. These indicators notify trainmen about to open a switch in the main track of the approach of a train on that track. All the indicators in the block show danger as soon as the train enters the second block in the rear, and until it has passed out of that block in which the indicators are located, so that there is no chance for a trainman to open a switch in the main track after an approaching train has passed the signal at the entrance of the preceding block, without full knowledge of the approach of the train.

In conjunction with this system of automatic signals there are placed at all junction points and grade crossings with other railroads interlocking signal towers

from which all the switches in the vicinity are operated mechanically by the man in the tower. Each of these switches is protected by signals, and these signals and switches are so interlocked that it is impossible for a wrong signal or signals governing converging routes to be given.

Backward movements of trains over switches at these interlocking points and movements on sidings are governed by special signals placed on the right-hand side of the track which they govern. In no case does a signal govern more than one track. All the signals at these plants are so interlocked that no signal can be thrown to safety until all the switches on the route which this signal governs are in the correct position, and all the signals governing movements over any portion of this route from other tracks are at danger.



ARRANGEMENT OF INDUCTION TELEGRAPH APPARATUS USED IN THE LEHIGH VALLEY RAILROAD TRIALS.

The Lehigh Valley system operates 1,090 automatic disc and semaphore signals and 1,660 interlocking levers located in eighty towers operating signals and switches.

Each division of the road has a signal inspector whose duties are to oversee maintenance of all the signals on his division and to have them kept in proper working order. This man has as assistants automatic and mechanical repairmen, battery-men, helpers, etc. He reports to the division engineer and to the signal engineer. The signal engineer is the head of the signal system. All matters pertaining to either the maintenance or installation of signals must pass through his office, and receive his approval. In this way all the appliances used, the manner of their installation, and, in fact, every detail, are made standard throughout the road.

TELEPHONE AT AUTOMOBILE RACES.

MOTOR-CARS QUICK, BUT TELEPHONE IS QUICKER.

To those interested in the practical side, the managing of the big automobile race recently held on Long Island, the extent to which the telephone was used in keeping tabs on the big racing cars and in transmitting orders and information is of more than passing interest. To telephone men, also, a description of the special telephone plant installed is of particular interest as an example of efficient telephone work under rather unusual conditions.

It was necessary to install and operate two distinct systems—the first, consisting of timing and checking circuits, in order that the cars entered in the race might be followed from the official stand and grand stand in their trip around the course, so that the officials and spectators might keep in touch with what was going on not only before them, but all around the circuit as well. Second, a system of private and public lines, in order that the newspaper correspondents and the general public might at any time communicate with the city or with other outside points.

TIMING AND CHECKING CIRCUITS.

To keep in touch with what was going on around the course, twelve telephone lines, connecting stations located at each of the twelve turns with telephones located at the official stand, and five timing circuits, connecting telephones in the official stand with telephones connected at the five, ten, fifteen, twenty and twenty-five-mile points respectively, were installed.

The telephones located at the turns and timing stations along the course were nickel desk sets, equipped with head and hand receiver, magneto and dry batteries enclosed within regular wooden cable terminal boxes attached to poles at the designated points. The telephones at the official-stand end of these lines were nickel desk sets, with head and hand receiver, magneto and batteries, placed along a shelf on the second floor of the stand. When bulletins were received a force of clerks indicated the drivers' places on a great map over the stand.

In order to make up the lines connecting the telephones in the pole boxes with the telephones in the stands, four miles of twenty-five-pair lead cable were placed temporarily on poles from the official stand to a point at Albertson, where suburban toll trunks, additional cable facilities to Roslyn, connecting with existing wires on poles toward Great Neck, were available, and could be used to complete the circuit.

NEWSPAPER AND PRIVATE LINES.

The Associated Press and several of the newspapers installed private lines from their offices to the official stand. Several other special circuits also were installed, including one to the private car of President Peters, of the Long Island Railroad, located at a siding just north of the Jericho Turnpike, at Mineola, and several circuits to the headquarters of the various automobile companies located near the course. A telephone line was also established between the official stand and the band stand for the purpose of directing the bandmaster.

To accommodate the general public, and such newspaper correspondents as had not contracted for private lines, a two-position switchboard was installed in a portion of the official stand with trunk-line connections to the Long Island toll-board, the Roslyn central office, the Garden City central office, and tie lines to the switchboard at the Garden City Hotel. From this switchboard extensions were run to the public telephone room at the official stand, the grand stand, and various important points nearby.

The total circuit mileage of the timing and checking system was seventy-eight miles; the total mileage of the newspaper system, 215 miles; the pay-station system, 155 miles, making a total mileage of 448 miles. Of this total mileage 292 miles of existing circuit was used, and 156 miles was placed temporarily. The entire system was efficiently operated, an ample force of uniformed operators, attendants, messengers and supervisors being provided. A special pay-station department inspector was also on hand to look after any irregularities that might arise.

In spite of this ample equipment there were occasional periods when the demand for service taxed the installation to its fullest capacity. There was, however, no delay. The service was efficient and satisfactory in all respects.

This telephone service was installed and maintained by the New York & New Jersey Telephone Company.

Illuminating Engineering Society.

THE first fall meeting of the Illuminating Engineering Society was held at the Edison Auditorium, New York city, Friday evening, October 12, with President Louis B. Marks in the chair. At this meeting, following the resolution adopted at the meeting of the council, the New York members were organized as a New York section of the society. This action has been taken in order that the work of all the sections may be given the same weight. The general policy of the society will be governed by the council, but the management of each local section will be left largely to its officers. The following temporary officers were elected for the New York section: Alfred Forstall, consulting gas engineer, chairman; Frank A. Pattison, consulting electrical engineer, first vice-chairman; Dr. F. Schniewind, consulting chemical engineer, second vice-chairman; Preston S. Millar, expert with the Electrical Testing Laboratories, secretary.

A brief report was submitted by Secretary Elliott. It shows that the society has collected $1,802.50 from dues, sales of transactions and advertising, and has expended $1,276.18, leaving a balance of $526.32. The membership is now 750.

Two interesting papers were read and discussed. The first, submitted by Ernest C. White, illuminating engineer, Winnepeg, Manitoba, was entitled "Application of Photometric Data to Indoor Illumination." In the absence of the author it was read in abstract by Dr. Clayton H. Sharp. It calls attention to the somewhat troublesome methods in use for solving problems in illumination. These questions are generally decided by means of candle-power polar diagrams, curves which show the intensity of the light emitted in all directions. What the illuminating engineer wishes to know, however, is not the intensity of light emitted by a certain source, but what amount of illumination a certain source will give at a certain distance and in a certain direction. In order to obtain curves showing this feature, what are called uniform illumination curves are plotted—that is to say, a polar diagram showing the distance away in all directions from the source of light at which an equal illumination is obtained. These diagrams may be plotted for different types of lamps or lamps fitted with different types of reflectors, one diagram of each kind being sufficient for lamps of all candle-powers. By means of a number of scales laid off at the side of the diagram and the concentric circles drawn on the diagram, it is easy to interpolate what distance away from the source of light a given illumination in candle-feet will be obtained in any direction. With a diagram of this kind for a given combination of lamp and reflector it is a simple matter to figure out from any assumed grouping of lamps the illumination in candle-feet which will be obtained at any point.

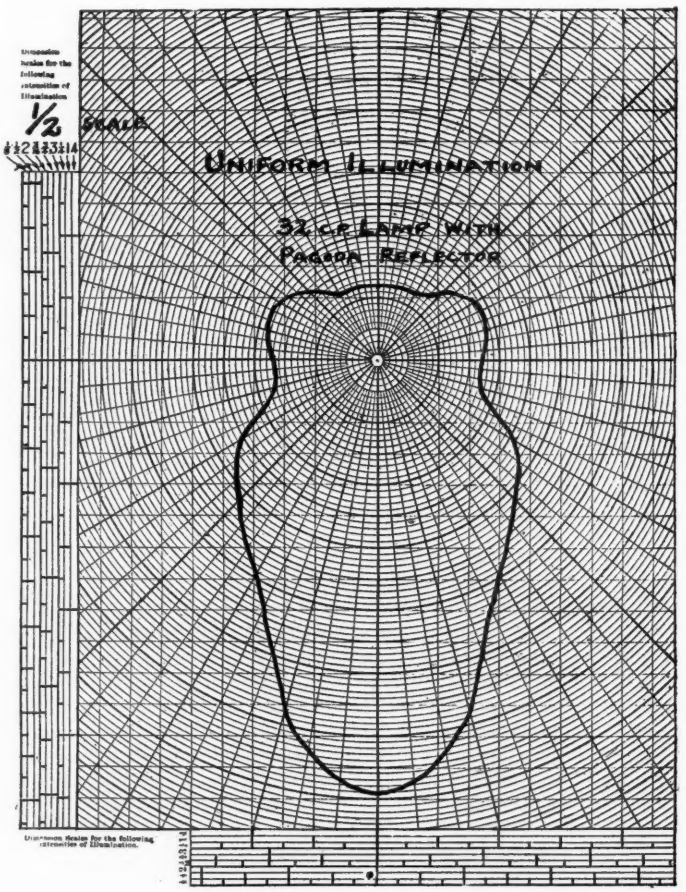


FIG. 1.—POLAR DIAGRAM OF UNIFORM ILLUMINATION FROM AN INCANDESCENT LAMP.

Fig. 1 represents the uniform illumination from a thirty-two-candle-power incandescent lamp with a pagoda reflector.

Each of the various scales is labeled in foot-candles, *i. e.*, each scale applies correctly to the curve for the intensity of illumination marked above it. Thus the illumination directly below the lamp will be one foot-candle at fourteen feet distance (*i. e.*, seven divisions on the one foot-candle scale equals fourteen feet, the curve being plotted to one-half scale); four foot-candles at seven feet distance; three-fourths foot-candle at sixteen feet distance; two foot-candles at ten feet distance; one-eighth foot-candle at forty feet distance, etc. In order to calculate illumination at an angle of forty-five degrees from the vertical, the radius of intersection is swung around to a line parallel to the scales, the reading then being 0.5 foot-candle at nine feet distance, etc., if the rays are incident to the plane to be illuminated. If the plane in this case were horizontal, the horizontal and vertical rulings (provided on the coordinate paper to facilitate reference to the scales) easily permit of swinging a radius proportionate to 0.5 foot-candles illumination through the angle of incidence and thus reading with close approximation the actual illumination, which would be about 0.35 foot-candle at nine feet distance. Attention was called to several advantages that were thought to result from the use of these curves. The shape of the curve represents the effect produced, which is not

the case with the ordinary polar distribution curve. The area of the curve is not so largely affected by the character of distribution as in the polar distribution curve. The curves of uniform illumination afford instant reference to the best location for lights—that is, the proportion of distance from ceilings and floors, the best angles for bracket lights, etc. The paper then showed the application of this method to fixture design, and pointed out that it is not extravagant to expend a good deal of careful calculation and thought on the design of a fixture when it costs from $200 to $300.

The second paper was read by J. E. Woodwell, illuminating engineer for the Federal government, the title being "Data on Indoor Illumination." Mr. Woodwell emphasized the fact that the intensity of illumination should be varied according to the character of the work to be done, but that there are no fixed limits in any case, since the eye accommodates itself to considerable variation. He directed attention to the present demand for a simple, practical "illuminometer" which shall be portable, accurate and low-priced. There is need for a large amount of data showing the results of different methods of lighting, for since there is no simple connection between the physiological effect and the amount of light given out, we must depend upon the results of successful plans to guide us in this work. It has been found that in the postal service, for example, for reading addresses of mail in an endless variety of forms, pencil, pen and print, on backgrounds of various color, a local illumination of from two to four foot-candles has been necessary. Two foot-candles is generally sufficient for desk illumination, though if much detail is involved, three and even four foot-candles is not excessive. For corridors, public places and assembly rooms the figures range from one-half to one and one-half foot-candles, while in stores where dark goods are displayed and a brilliant display is desired, five to ten foot-candles is not uncommon. The latter amount of illumination is also required for tracing, drawing and engraving. These intensities relate to the working plane, and, in addition, consideration must be given to the walls and ceiling and whatever objects in the space are to be illuminated. The figures determined upon for this purpose will depend principally upon the color and reflection value of such surfaces. The deceptive character of the candle-power distribution curves as usually plotted was pointed out, and it is shown that the effect produced by reflectors is not always made clear. For instance, a reflector may be used which will take only a small part of the light thrown out in a horizontal direction, yet will give a very intense illumination in a vertical direction. For studying illumination problems the Rousseau diagram is often more valuable than the candle-power diagram, since it shows the total amount of light given out by the illuminant. The author gave the usual method of solving illumination problems, and then passed to a consideration of actual cases. By means of lantern slides the results accomplished in a large number of public buildings where various methods of lighting are in use were shown, such as classrooms, post-office departments, courtrooms, reading rooms and other interiors. In some cases the method illustrated has been found highly successful. The use of Cooper Hewitt lights in the New York post-office has given excellent results. For sorting mail a lamp with a reflector concentrating the light downward on the desk and pigeon-holes is good, but should be supplemented by general illumination in the room. Good results are being accomplished by means of the Welsbach lights. Several examples of lighting large interiors, such as courtrooms, were illustrated, and the systems described somewhat in detail, the method of wiring being explained. Some cases in which the illumination was bad were also shown, the troubles being pointed out and possible remedies suggested.

The discussion was opened by E. L. Elliott, who said that the method proposed by Mr. White for solving illumination problems was of very great value and represented the first important step in advance since that made by Rousseau. He thought, however, that the diagram might be simplified a little bit, stating that it is very easily plotted from the ordinary candle-power curve. Mr. Woodwell's paper was also of very great value, since it gives the results of a large amount of actual work; it is just such results as are being sought by illuminating engineers.

Dr. A. H. Elliott expressed his appreciation of the two papers presented, and said that he was struck by the amount of attention which electrical engineers have been giving to problems in illumination. Gas engineers have been devoting their attention to securing a large amount of light per cubic foot of gas, and to devising gas lamps of great intensity. The gas engineers should realize that the direction in which the light is given out is as important as the amount. Attention was called to the high efficiency of plaster of Paris as a reflector, about eighty per cent of the incident light being reflected. This, he thought, might be employed as a means of diffusion, instead of glass shades.

W. H. Gardiner asked why the general public to-day believes that the gas furnished is poorer than that of ten or twenty years ago. He himself has been led to the conclusion that the introduction of lamps of higher intrinsic brilliancy in public buildings has led to this dissatisfaction, because of the contrast thus created. Gas engineers know that the gas furnished to-day is better than that of ten years ago, but a gas user, in going into his home from a brilliantly lighted building, is struck with a feeling of gloominess and attempts to overcome this by lighting three or four burners.

R. M. Searle thought that the position of the gas burners might have something to do with the trouble. Formerly side lights placed four feet from the floor were much used. To-day they are placed seven feet from the floor even where dependence is not put entirely upon a central chandelier.

H. H. Seabrook pointed out that the intensity of illumination does not determine the visibility. As shown by Helmholtz thirty years ago, a brilliant illumination, particularly one rich in actinic rays, causes a great contraction of the retina and may result in poorer definition.

Dr. C. H. Sharp said that the standard of illumination has been steadily increased, and this is the reason for the dissatisfaction. Buildings lighted by methods satisfactory twenty years ago now, by contrast, seem dismal. Attention was called to the fact that the introduction of more efficient gas lamps such as the Welsbach had not decreased the sale of gas, but had, in fact, increased it. The public, instead of reducing its consumption of gas, is buying more light. He thought that the same result would be found from the introduction of the more efficient types of electric lamp.

Mr. Gardiner agreed with Dr. Sharp, and called attention to a recent discussion of the matter in which it was held that the sixteen-candle-power incandescent lamp is now out of date.

President Marks took issue on this point, saying that although, no doubt, the present dissatisfaction is due to a toning up of our standards of illumination, that we have gone very much too far. He asked whether any one had data regarding the intensity of illumination given by a ground-glass window on a bright day. This he held to be ideal, and, from measurements of his own, thought that it might be as low as one-fiftieth of a foot-candle. This is what we should aim for. At the present time we use too great brilliancy.

The meeting was then adjourned.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

A Study of Starting Hoisting Apparatus when Operated by Continuous-Current Motors.

The usual method employed in determining the resistance of the successive steps in a starting rheostat when used for hoisting motors is well known, and this may be carried out either analytically or graphically. It is usual in such cases to decide upon a limiting current value which bears a certain relation to the full-load current. When this is done the total starting resistance, including that of the armature, is given by dividing the applied electromotive force by the maximum allowable current. Each successive step in the rheostat then bears to the preceding one the ratio of the starting to the normal current. The same method may be employed when it is desired to maintain a constant acceleration during the start. This system does not, however, take into consideration the effect of the self-induction of the armature and of the rheostat, and this phase of the problem is taken up here by G. Hacault. The author considers first the mechanics of the problem of starting a motor when lifting a given load. From this he deduces an equation involving this load and the constants of the apparatus, which shows that the inductance of the starting circuit has a considerable effect upon the performance of the motor. The equation is solved to determine the limiting values, and curves are plotted to enable it to be made use of graphically. The experiments verify the analytical consideration, showing that the inductance of the circuit makes it allowable to reduce considerably the starting resistance, and it was found that, in some cases, it would seem desirable to wind this resistance on an iron core, so as to increase its inductance.—*Translated and abstracted from L'Éclairage Électrique (Paris), September 22.*

Wireless Telegraphy for Railway Signaling.

The idea of applying wireless telegraphy to railway use is not new, if one include under this item the early attempts of Phelps, Smith, Brown and others with the so-called induction systems. So far no actual use is being made of the new system of communication for controlling railway trains, but Dr. E. Nesber describes here some interesting experiments made in this field near Berlin. A station was equipped with apparatus of the Telefunken system, and a horizontal aerial was adopted, about 210 feet long, 190 feet of which was stretched between two telegraph poles twelve inches below the telegraph wires, the remainder of the length being made up of the connections to the sending apparatus. A car attached to a steam-hauled train was fitted up with the receiving aerial, consisting of a horizontal rectangle of wire supported on six short posts. The receiving apparatus was placed in one compartment of this car. Experiments were made to determine the distance to which signals could be sent with certainty, and the influence of overhead wires. It was found that the latter, when directly over the car, interfered somewhat with the clearness of the received message. The experiment is thought to indicate that for railway signaling purposes a system of wireless telegraphy such as that used in this work can be depended upon to transmit messages about seven and one-half miles, and that with more attention to the equipments of both the fixed and moving stations, greater distances can be covered. The operation of the system was found in no way to interfere with that of the ordinary telegraph lines running along the road.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), September 27.*

Applications of Rare Metals to Incandescent Lighting.

As was pointed out by Féry, carbon at the temperature it attains in the incandescent lamp is not an efficient optical radiator. It is exceeded by chromium oxide, platinum, magnesia, zirconia, lime, lanthanite, thoria, and the Auer mixture of thoria and ceria. From Féry's figures it would seem that certain of these substances, at the temperature of 1,400, have an efficiency six times greater than that of carbon. It was this fact that led up to the numerous recent attempts to substitute some other material for carbon in the incandescent lamp. The work which has so far been done is reviewed here by J. Izart, who points out that although the materials mentioned give much better efficiencies, and may even be still further improved by carrying them to higher temperatures, nearly all of them are deficient in mechanical properties. Platinum, in fact, may be employed and give twice the efficiency of carbon, but this does not make a satisfactory lamp. The author then passes to a discussion of the more recent work in this direction. Titanium, which has been proposed, is found in great abundance throughout the surface of the globe. It is as widely distributed as carbon and iron, and may be considered as one of the principal constituents of the terrestrial crust. It is found in nearly all crystalline rocks, bauxites and iron ores, and is much more abundant than tantalum, tungsten, or molybdenum, so that if it can be employed successfully for making a filament, such lamps should not be expensive. On the other hand, tantalum is not so widely distributed. In fact, it is found in small quantities associated with earths and sands, from which it is extracted with difficulty. It is accompanied very often by tungsten and the materials of the tin group, such as niobium yttrium, uranium and the rare earths. For these reasons a metallic tantalum will command a high price. Tungsten, while more abundant than tantalum and molybdenum, still possesses the disadvantages of titanium. Its minerals are wolfram, an oxide of tungsten, and scheelite, calcium tungstate. Kuzel, employing filaments of tungsten, has secured specific consumptions of 0.4 watt per candle. It is pointed out that in the present state of the art, when so many different metals are being suggested for use in incandescent filaments, that the relative luminous efficiencies of the methods should be determined, so that an intelligent idea of their relative values might be secured.—*Translated and abstracted from L'Industrie Électrique (Paris), September 25.*

Electric Traction in the Simplon Tunnel.

The putting into use of the electric railway system of the Simplon tunnel is a noteworthy piece of work carried out by Brown, Boveri & Company. This company offered, during the summer of 1905, to equip the tunnel and its termini for

electrical operation and have the system ready for operation the following summer. Due to a delay on the part of the tunnel company to decide finally upon the matter, the electrical company did not receive the contract until late last fall. For this reason it decided to install a three-phase system, simply because it could put such a system into service more quickly, and not because it believed that this system was better suited for the work than other proposed plans. It happened that Brown, Boveri & Company was building at that time two new locomotives for the Valtellina line, and by agreement with the Valtellina company transferred these locomotives to the Simplon company and secured from the former three other electric locomotives which that company had in service. This supplied the five locomotives necessary to keep the system in operation, four being required to haul the trains through the tunnel. Two power-plants were erected, one at Brigue, the Swiss end of the tunnel, equipped with a 1,200-horse-power plant; and the other at Iselle, the Italian end where a 1,500-horse-power plant has been installed. These two plants operate in parallel on the line, and are sufficient for the present tunnel service. The pressure employed is 3,300 volts at sixteen cycles. The tunnel is divided into five sections: from the station at Brigue to the northern end of the tunnel, the northern half of the tunnel, a siding in the middle of the tunnel, the southern half of the tunnel, and from the southern end to the Iselle station. Section switches are provided at the two stations and at the middle of the tunnel, as well as a telephone system. At the northern end of the tunnel the overhead line is carried on steel cross-wires strained between poles of hard-drawn steel, which are placed on each side of the track. Poles consist of two members, and on curves are stiffened by a third member, forming a tripod. At the southern end of the tunnel there is a separate set of poles for each track, making a very solid construction and enabling the work to be carried on on any one track without disturbing the others. In the tunnel the conductors are carried on steel cross-wires stretched between gun metal studs cemented directly into the face of the tunnel. No strain insulators are used, as it is necessary to keep the overhead work in the tunnel as simple and as strong as possible. The cross-wires are insulated at each end of the gun metal studs by strong porcelain insulators, allowing the cross-wires to be drawn as tight as required. The cross-wires are about eighty-three feet apart on straight portions of the line, and forty-two feet on curves. No trouble due to change in temperature is met with in the tunnel. A special type of insulator supports the trolley wire, this being made of a porcelain body carried on an ebonite bolt. The complete insulator is carried on a gun metal fitting. These insulators are tested at 40,000 volts. The section of conductors is 0.15 square inch in the tunnel, and one-half this outside. The double cross-section in the tunnel is obtained by using two wires, and is intended to prevent too great a fall of potential along the line, as well as to give additional surface of contact. The two overhead conductors are zigzagged slightly over the track, so as to equalize the wear on the trolley. The rails are bonded with a plastic joint, so that the ordinary fish-plates only are used to conduct the current from one rail to the other. The locomotive employed, which is also discussed here, was described in the ELECTRICAL REVIEW for July 14.—*Abstracted from the Electrician (London), September 28.*

A Large Steam-Turbine-Driven, Continuous-Current Dynamo.

In an article on the steam turbine department of Richardsons, Westgarth & Sons, Hartlepool, England, is given an interesting description of a large direct-current dynamo direct-connected to a steam turbine. This company builds steam turbines under the Parsons patents, and is the English representative of Brown, Boveri & Company, of Baden, Switzerland. The dynamo was built by the latter company, and is intended for the Lisbon electric tramways. The machine has an output of 1,000 kilowatts, and runs at a speed of 1,260 revolutions per minute. It is stated by the author that at the time he inspected it the machine was carrying a load of 2,100 amperes, corresponding to an overload of fifteen per cent in current, without sparking, although the voltage of the machine was below the normal because of an insufficient steam supply. The normal potential is 550 volts, and the allowable overloads are ten per cent for three hours, twenty per cent for one hour, and fifty per cent momentarily, all at the normal voltage. The rotating armature is of the slotted drum type with ample provision for circulation. The windings are held in the slots by hardwood wedges, while the parts of the windings overhanging the ends are covered and positively held by metallic caps cast from a special alloy of great tensile strength. The commutator is of hard-drawn copper and mica, and is strengthened by four steel rings shrunk on. The four-pole magnet system, which, in appearance, nearly resembles the stator of an induction motor, consists of soft-iron core plates carried on a cast-iron frame and well ventilated. It is provided with two distinct windings—a shunt winding and a compensating winding displaced from the former by an angle of ninety electrical degrees. This compensating winding enables the machine to work with brushes fixed at all loads from zero to fifty per cent overload without injurious sparking. At the same time, as it carries all or a part of the main current, it can be adjusted so as to give the dynamo the characteristic of a level-compounded, over-compounded or under-compounded machine. The dynamo is to run in parallel with existing slow-speed machines in the Lisbon tramways power-station, and was required to have an over-compounded characteristic. Instead of making use of the above-mentioned feature of the compensating winding, the builders have provided a special compound winding, thus making the brush position independent of the compounding. A direct-coupled, six-pole exciter is provided, giving thirty-eight amperes at 100 volts, with the armature mounted on the end of the shaft. "Galvano" metallic brushes are used on the generator with small carbon pilot brushes set slightly in advance. There are twelve copper and six carbon brushes per pole for this machine. Special care was taken in balancing the rotating parts so as to eliminate all vibration. The temperature limit of the hottest part of the commutator or windings was specified to be forty-five degrees above the temperature of the surrounding air after a run of ten hours at normal full load. The insulation of the generator windings was tested to the frame with an alternating pressure of 1,100 volts. Forced ventilation is provided by means of vanes on the end of the armature spider, which draw air from under the bed-plate and discharge it through an opening in the top of the frame after circulating through all parts of the machine. The separate exciter is provided to avoid a tendency to racing which might exist if the machine were self-exciting with the system of compound windings employed. With this exciter the exciting voltage increases with the speed, checking any tendency to race when unloaded.—*Abstracted from the Electrical Review (London), September 28.*

Methods of Getting New Business

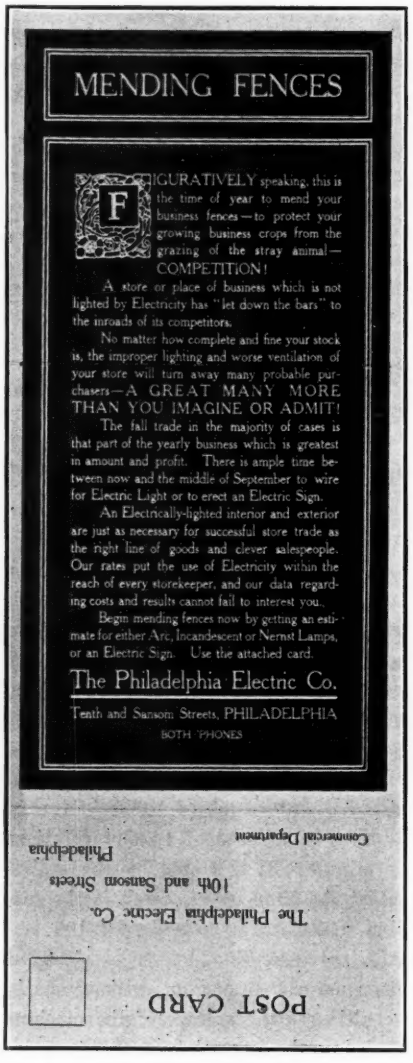
A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

The accompanying illustration is a reproduction of an advertising folder recently issued by the Philadelphia Electric Company, Philadelphia, Pa. While the cover design, which is in black and red, contains no direct reference to anything electrical, the idea has force in creating an inquiry as to the logic of the expression "mending fences." If this bulletin, therefore, attract any attention whatever it will hold it until an analysis is made of the argument which adorns the inside. There is a good deal of food for thought in this argument, and it is understood that the folder has been the means of securing a number of direct replies which have resulted in closing business.

THE FRONT VIEW OF THE FOLDER.

A. Hugh Seabrook, the engineer and manager of the West Ham (England), Corporation Electricity Supply, is one of the most enterprising of the British central-station managers. In some recent correspondence with Mr. Seabrook he has taken exception to various extracts from American journals published in the London technical papers, creating an impression that the managers of electric supply concerns in Great Britain—especially municipal propositions—are not up to date with regard to selling their commodity. Herewith is reproduced the cover page of the *West Ham Electrical Bulletin*. In addition to considerable advertising, the July issue of this bulletin contained an editor's page, some very interesting information concerning the definition of units, prices for various installations, a complete layout for a six-room, eight-room and ten-room house, a list of local electrical wiring contractors, and statements concerning the progress of electricity supply in West Ham, as well as a number of other articles relating to apparatus, notes of scientific interest, and a page of special interest to the tradesman.


MENDING FENCES
FIGURATIVELY speaking, this is the time of year to mend your business fences—to protect your growing business crops from the grazing of the stray animal—COMPETITION!
A store or place of business which is not lighted by Electricity has "let down the bars" to the inroads of its competitors.
No matter how complete and fine your stock is, the improper lighting and worse ventilation of your store will turn away many probable purchasers—A GREAT MANY MORE THAN YOU IMAGINE OR ADMIT!
The fall trade in the majority of cases is that part of the yearly business which is greatest in amount and profit. There is ample time between now and the middle of September to wire for Electric Light or to erect an Electric Sign.
An Electrically-lighted interior and exterior are just as necessary for successful store trade as the right line of goods and clever salespeople. Our rates put the use of Electricity within the reach of every storekeeper, and our data regarding costs and results cannot fail to interest you.
Begin mending fences now by getting an estimate for either Arc, Incandescent or Nernst Lamps, or an Electric Sign. Use the attached card.
The Philadelphia Electric Co.
Tenth and Sansom Streets, PHILADELPHIA
BOTH 'PHONES
POST CARD
The Philadelphia Electric Co.
10th and Sansom Streets
Philadelphia
Commercial Department

ANOTHER EFFECTIVE FOLDER.

We have received from the Dallas (Tex.) Electric Light and Power Company, through M. W. Powers, of the soliciting department, a handsome set of souvenir postal-cards depicting various local scenes of interest.

In a conversation with a central station man connected with one of the largest lighting and traction interests of the country, the matter of courtesy on the part of the company's employés was touched upon. This subject was brought up in commenting upon Arthur Williams' recent address at the Hotel Frontenac before the Association of Edison Illuminating Companies. It was in this direction alone, said Mr. Williams, that the privately owned corporations has an immense advantage over the municipally operated plant. "But," said the other central station man, "in a very great number of cases you will find that somebody's brother or his brother-in-law is at the head of these departments, and is imposing upon this relationship, and in his brusque treatment of consumers is building up a wall of dissatisfaction." We have heard this before. Now, as a matter of fact, if a consumer's bill for light, say in February, was $3.70, in March and April $3.50 each month, and in May $5.25, when the consumer knows, that, if anything, he has burned less light than hitherto, it is barely possible that his meter is running fast (and sometimes meters do run fast), and his complaint should be listened to patiently, the matter explained and assurance given him that full satisfaction will be his.

THE BULLETIN OF THE WEST HAM (ENGLAND), CORPORATION ELECTRICITY SUPPLY.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A Portable Lamp Guard.

The accompanying illustration shows the portable lamp guard placed upon the market by I. P. Frink, 551 Pearl street, New York city. There has long been a demand for a portable lamp guard that could be used by the most careless workman without injury to the lamp.

The ribs of the guard are made of galvanized bessemer steel, and their strength lies in their depth rather than in the thickness of the ribs. This is a desirable point, as there is a minimum obstruction of the light from the protected lamp.

The guard has had a thorough test by electrical and mechanical engineers of leading railroads, and has been widely

PORTABLE LAMP GUARD.

adopted. It is of great utility around lighting plants, car barns, pits, breweries, freight terminals and similar installations.

Owing to the tapered fitting in the handle through which the reenforced cord is drawn and knotted there is no strain on the terminals nor the sockets. This is a feature which appealed strongly to an engineer who recently advised a large order for use in a prominent cotton mill.

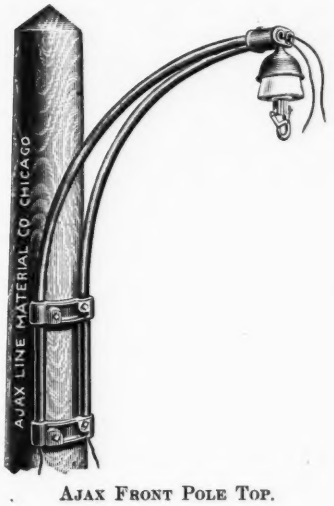
New Pole Fixtures for Arc Lamps.

The use of brackets or some other type of pole suspension for arc lamps which does not necessitate the undesirable span wire and a second pole is becoming more and more popular. At times the lamp may be placed directly over the pole without casting bad shadows, as is the case when there are trees on the street; but, more often, the illumination will be better when the lamp is held a little in front of the pole.

In order to meet these two conditions the three types of fixtures shown in the accompanying illustrations have been brought out by the Ajax Line Material

AJAX UNIVERSAL POLE TOP.

Company, Chicago, Ill. They are designated, respectively, as a universal pole top, forward pole top and front fixture. All of these fixtures are wired through the piping and are fitted with the high-



AJAX FRONT POLE TOP.

voltage type Ajax arc lamp insulators. The company's universal pole top is given an extra wide spread of the pipes, leaving ample room for a reflector above the lamp. The forward pole top also allows for such a reflector.

The front fixture may be used at any height on the pole, so as to allow the cross-arms to be placed above it on tall poles. This type is made with either a two-foot or a three-foot reach, and the latter size is supplied with pulleys for lowering the lamp if desired.

All three of the new fixtures can be

AJAX FORWARD POLE TOP.

fastened readily to either round or square poles, while the front fixture may be used on walls as well.

The Rail Joint Company.

The enlargement of the steam rolling mill of the Rail Joint Company, at Troy, N. Y., known as the Albany Iron and Steel Works, has been completed. The rolling mill building is 400 feet long, independent of machine shops and other buildings.

An electric crane with a range of 600 feet carries steel billets from the yard, constantly feeding the furnaces, so as to supply two twenty-one-inch trains that are in operation day and night rolling rail joints for T and girder rail sections for steam and electric railways.

The Troy mill has a capacity to roll

over 145 different sections of rail joints and an annual output of 50,000 tons. There are over 350 men employed in its operation. A railroad siding or switch from the New York Central & Hudson River Railroad runs around the property, bringing raw material, coal and steel billets into the yard and removing finished parts.

Special attention is being given to the production and perfection of girder and insulating rail joints of various base-supported types. Over 25,000 miles of track are equipped with the company's base-supported rail joints.

While the Rail Joint Company owns the works at Troy, it has nine other distributing points where its patented machinery is in use to produce rail joints under contract. Deliveries are made from Buffalo and New York city, N. Y.; Newark, N. J.; Newcastle, Del.; Steelton and Pittsburg, Pa.; Chicago and Joliet, Ill., and Milwaukee, Wis.

The company's general offices are at 29 West Thirty-fourth street, New York city, and it also maintains fourteen branch selling agencies.

Fires Not Caused by Electricity in Germany.

Electricity has often been accused of causing fires, but this has not been the experience of Herr von Moltke, who considers that the danger is infinitesimal if the electrical installation has been carried out in accordance with the recognized rules. The total loss through fire in Prussia in the years 1900, 1901, 1902 and 1903 amounted to ninety-seven, ninety-two, seventy-six and ninety million marks respectively, and of this only two, two, one, and one and one-half million marks, respectively, are officially ascribed to electrical causes. Even this small percentage would probably be reduced by careful investigation.

It has often been suggested that the overhead wires of electric tramways, etc., would give trouble in case of fire, and elaborate precautions for disconnecting these in case of need have been insisted on by the police in certain towns. An enquiry addressed to thirty-eight German towns asking whether this disconnection has at any time been necessary has been replied to in the negative in every case except that of Hamburg. The same enquiry sheet elicited the fact that death or serious injury has never been caused to anybody at a fire in these towns through electrical installations, in spite of the fact that a number of personal injuries of various kinds occur at almost every important fire.

With regard to danger of shock to firemen through squirting high-tension mains, experiments have shown that this is a real danger, but at the same time extremely little damage has resulted from this cause, chiefly owing to the careful instruction given to the firemen. This instruction often includes particulars of all the electrical installations in the town as well as notes as to the avoidance of shocks, and as to the first aid to be given to persons suffering from electric shock.—*Journal of Electricity, Power and Gas.*

An Allis-Chalmers Hoisting Engine for the Chapin Mine.

The Chapin mine, in the heart of the city of Iron Mountain, Michigan, and known for many years as one of the largest producers in the Lake Superior region, is to have added to its present equipment a new Allis-Chalmers duplex, single-drum hoisting engine of the first-motion type, built by the Allis-Chalmers Company, of Milwaukee, Wis.

The new hoist, which was recently ordered, will have cylinders thirty-four inches by seventy-two inches and will be fitted with Reynolds Corliss valve gear, with automatic cut-off and governor and with Stephenson link motion. The shaft will carry a composite drum twelve feet in diameter by ten feet on the face, keyed to the shaft and grooved for one and three-eighths-inch ropes. The hoist will have a capacity of 26,400 pounds at a speed of 1,900 feet per minute when supplied with steam at a pressure of 125 pounds.

The valve gear, actuated by a link motion of the Stephenson type, will be reversed by separate steam apparatus.

The engine will be fitted with a device for automatically closing the throttle valves, when the cage reaches the desired position in the shaft. This device is driven by means of gearing from the drum shaft, and connected with the reversing gear so that the throttle valves can not be opened until the engine is reversed. In addition there will be provided a device which will automatically apply the brake when the cage reaches the desired point so as to prevent overwinding.

The drum brake will be of the steel-band pattern, fourteen-inch face, and lined with wood blocks. The brake will be applied by a heavy weight and released by steam.

The engine will be of the horizontal pattern fitted with oil cataract cylinder and controlled by a hand lever on the operating platform. Each cylinder will be fitted with a quick-opening throttle valve. One twelve-inch throttle valve is in the centre of the steam pipe below the platform and controlled from the engineer's platform located between the cylinders and carrying throttle, auxiliary throttle, reverse, and brake levers. The frame used for this engine will conform to the standard Allis-Chalmers heavy-duty type.

The weight of the empty skips carried by this hoist, two in number, is 4,000 pounds each, while the weight of ore in the skips is approximately 14,000 pounds. The maximum depth of the lift is 2,500 feet. The total load, including ore, skips and rope, is 29,500 pounds. The unbalanced load, ore and rope, is 21,500 pounds.

This outfit constitutes the third piece of Allis-Chalmers equipment installed in this mine. The second is the Cornish pump built many years ago and installed in one of the older shafts but lately used to drain the new "C" Ludington shaft. Its capacity is 3,000 gallons per minute from a depth of 1,500 feet. The other equipment is the Allis-Reidler pump, and is one of the largest in use in any mine on the globe. It is located in the Hamilton shaft, where it handles 2,000 gallons per minute, which it lifts over a quarter of a mile to the surface.

A New Steam Relay Plant for the Washington Water Power Company.

W. S. Barstow & Company, of New York and Portland, Ore., have been retained as consulting engineers by the Washington (Oregon) Water Power Company to design its new steam plant. This is a relay plant and is for the purpose of the insurance of good service, particularly in case of any accident to the transmission lines of the various water-power plants of the company. The present installation will be about 8,000 horse-power. Steam turbines will be used for power generation, and the plant will be modern in every respect. The Washington Water Power Company was one of the original pioneers in the long-distance transmission, one of its transmission lines extending into the Coeur D'Alene country, a distance of about 110 miles, and having a potential of 60,000 volts.

Current Electrical News

DOMESTIC AND EXPORT.

OAXACA SPRINGS (MEXICO) FOR POWER—A despatch from Oaxaca, Mexico, states that Ing. Andres Brandenburg has obtained a concession from the state of Oaxaca for the use of the waters of the spring known as Ojo de Agua for the purpose of using it to generate motor power for the production of electricity to light up the towns of Tehuantepec and Juchitan.

JOHN R. WALSH ROADS FILE TRUST DEED FOR $11,000,000—The Chicago Southern and the Southern Indiana Railway companies, two of the lines owned by John R. Walsh, of Chicago, have filed a trust deed conveying to the Girard Trust Company, of Philadelphia, all of their lines, equipment, and other properties, to the value of $11,000,000, as security for a loan of $5,500,000.

INDIANA TRACTIONS TO CONSOLIDATE—A meeting of capitalists from Pittsburg, Louisville, Indianapolis, Cincinnati and Evansville has been held in Evansville, Ind., and it has been decided to merge the Evansville and Eastern traction line, Evansville and Newburg, Evansville and Boonville and Evansville and Mount Vernon traction lines. It is stated positively that the deal has been consummated and that the new company will organize and incorporate within two weeks, with a capital stock of $3,000,000. One of the plans of the new company will be to extend the Evansville and Mount Vernon line to New Harmony and to build the proposed Evansville and Cannellton line and extend it to Louisville along the Ohio river.

TO TAKE OVER LAKE ERIE & MIAMI CANAL TOWING FRANCHISE—The Lake & River Transportation Company, of Hamilton, Ohio, has been incorporated by the following men from Cleveland: W. B. Whiting, Attorney C. E. Sanders, R. F. Denison, C. C. Owens and A. J. Sperry. The object of the formation of the company is to take over the "electric mule" franchise and the rights to operate the Lake Erie and Miami canal by electric power, a right granted to George B. Cox, of Cincinnati, and others by the state legislature four years ago. The company headed by Cox is known as the Miami & Erie Transportation Company, and it is now in the hands of a receiver, the court having named J. C. Schmidlapp and C. C. Richardson, of Cincinnati, as receivers.

PLAN ELECTRIC PLANT FOR LANE COUNTY, ORE.—W. S. and Leland Spencer, capitalists of Seattle, Ore., have filed with the County Clerk, at Eugene, Ore., a notice of appropriation of 50,000 miners inches under a six-inch pressure of the waters of Triangle Lake, in the Coast Mountains, thirty-five miles west of Eugene, and of a power canal and a site for a power station. The Spencer brothers have given out little information concerning their plans, but it is known that they contemplate erecting a plant at the site filed upon for the purpose of furnishing power and light for Eugene, Junction and other valley cities. An electric railway from the valley to the Siuslaw country is also included in their plans for the future. The power site filed upon is considered one of the best in the state, and thousands of horse-power can be generated.

UNITED STATES TELEPHONE COMPANY TAKES OVER LINES OF THE FEDERAL TELEPHONE COMPANY—It is announced that the United States Telephone Company has taken over the lines of the Federal Telephone Company, controlling many exchanges throughout northern Ohio, and will begin operating them at once. The new issue of United States Telephone preferred and common stock has gone into effect. The preferred consists of $636,800 and the common consists of $1,100,100, which has been issued in exchange for securities carrying the control of the Massillon Telephone Company, the Findlay Home Telephone Company, Citizens' Telephone and Message Company, of Fostoria; Columbiana Telephone Company, Lancaster Telephone Company, Mansfield Telephone Company, Huron County Telephone Company, Stark County Telephone Company, Youngstown Telephone Company and the Zanesville Telephone Company.

NEW INDIANA TRACTION LINE—Indiana is to have another traction line, the Fort Wayne & South Bend Railway Company, which is proposed to extend between those cities. The company is to have a capital stock of $2,500,000, of which $10,000 has already been subscribed. Articles of incorporation have been filed giving the following directors: J. H. Garsamer, G. A. Wulkop, Charles A. Shorb, E. B. Swift, Perry Randall, W. F. Diemen, Charles M. Niezer, Val Brown and F. P. Randall. The proposed line will extend through the counties of Allen, Whitley, Noble, Kosciusko, Elkhart and St. Joseph, touching the following towns: Fort Wayne, Churubusco, Merrian, Wawasee, Syracuse, Mishawaka, South Bend and a number of smaller towns. The new company has asked for a right to construct its lines and to equip power plants in as many of the towns along the route as may be necessary.

BIG BEND WATER POWER COMPANY—The Big Bend Water Power Company, which controls twenty-eight miles of water rights below Spokane, has been reorganized with a capitalization of $2,000,000, and will build an electric line from Spokane to Coeur d'Alene, Ida., thence into the Coeur d'Alene district, connecting all the mining camps, the entire mileage being 154. The new officers are: B. F. O'Neill, Wallace, Ida., president of the State Bank of Commerce and president of the Idaho Northern Railway Company, president; J. W. Douglas, New York, vice-president; E. P. Spalding, vice-president and general manager of the Idaho Northern Railway Company, general manager; A. M. Philips, secretary and treasurer; Mr. Philips and J. H. Tilsloy, of Spokane, are also directors. Thirty thousand horse-power can be developed at the company's plant, for the equipment of which orders will be placed early in November.

NEW PUBLICATIONS.

SUBMARINE SIGNALS—The Submarine Signal Company, 88 Broad street, Boston, Mass., has published a pamphlet entitled "Submarine Signals," which includes the results of tests made by the United States Lighthouse Board during June and July, 1906, of the system of submarine signaling controlled by the company. This report is a very interesting commentary on the remarkable strides which have been made in the methods of communicating to vessels by means of submarine signals.

"THE SOUTH'S AMAZING PROGRESS" AND "ELECTRICITY: THE POWER BEHIND THE SOUTH"—Two important articles dealing with recent progress in the South have been reprinted in pamphlet form by the Southern Power Company, Charlotte, N. C. The first is by Richard H. Edmonds, editor of the *Manufacturers' Record*, Baltimore. It takes up somewhat in detail the progress in all industries which has been made there. The other is a reprint of an address delivered by W. S. Lee, Jr., chief engineer of the Southern Power Company, at the recent meeting of the American Cotton Manufacturers' Association, the theme being "Electricity: The Power Behind the South."

BULLETIN No. 18, ASSOCIATION OF LICENSED AUTOMOBILE MANUFACTURERS—The Association of Licensed Automobile Manufacturers, in bulletin No. 18, gives details and specifications for standard hexagon head screws, castle and plain nuts. This standard is to be known as the "Association of Licensed Automobile Manufacturers' standard for hexagon head screws, castle and plain nuts." During recent years manufacturers of fine machinery have found from experience that for a large portion of their work the United States standards for pitch of threads have been too coarse and the dimensions of heads and nuts too large. In order to secure satisfactory construction, special fine-pitch screw threads and smaller nuts have had to be made. The number and variety of these special threads and nuts have finally become such that great confusion, inconvenience and expense have been caused. To overcome this condition the association has adopted the new screw standard which is set forth in bulletin No. 18.

TELEPHONE AND TELEGRAPH.

PLYMOUTH, N. H.—The Baker River Telephone Company has about completed work on its system, and is installing new instruments in town.

BENTON, MICH.—The Michigan State Telephone Company asks to put in an underground system to cost $40,000. It will take nine months to complete the work.

ORANGE, CAL.—The Home Telephone and Telegraph Company has been engaged in extending its lines all over the county. In Orange a large force of men has been at work putting up poles and stretching wires, and the same work is going on at Anaheim, Tustin, Fullerton, Olive, Buena Park and other towns.

CINCINNATI, OHIO—The directors of the Cincinnati & Suburban Bell Telephone Company have authorized the issue of treasury stock to the amount of $325,000, the money realized to be voted to paying for a number of improvements and extensions. The stock will be allotted pro rata to present stockholders at par.

BOSTON, MASS.—President E. B. Field, of the Colorado Telephone Company, says that the increase in subscribers' stations in the territory covered by his company—Colorado and New Mexico—for the present fiscal year, to end December 31, will be close to 10,000, equal to a gain of nearly twenty-five per cent, and giving the company a total of 55,000 stations.

NEW YORK, N. Y.—A bulletin issued by the telephone companies operating in New York city, showing a gain of 7,584 telephones for September, has been issued. This brings the total number of telephones in service and under contract up to 276,000, and is approximately one telephone to every fourteen persons. If the present ratio of growth keeps up, there will be 600,000 telephones in New York city in 1910.

BRUNSWICK, GA.—Work on the new $8,500 building for the Southern Bell Telephone and Telegraph Company will start November 1. The second floor will be used for the exchange with offices on the first floor. Work on the underground conduit system will start shortly after the building is under way. All telephone wires in the business section of the city will be put under ground. New wires will be put in and every part of the old exchange taken away, so that when completed the exchange will be new throughout. It will represent a $100,000 investment.

SCOTTSBORO, ALA.—The local telephone exchange and its lines, which have been operated as an independent system, have been sold by W. L. Moody to local citizens, who propose to incorporate the company with a capital of $25,000 and greatly improve and extend the system. The new owners contemplate putting in a copper circuit from Decatur to Chattanooga in the near future, also the installation of exchanges at Stevenson and Bridgeport. The system has been a paying one. The new officers are: Dr. J. O. Lipscomb, president; J. W. Gay, secretary; L. W. Rorex, treasurer; D. E. Barclal, manager, and the Hon. John F. Proctor, attorney.

OMAHA, NEB.—The Independent Telephone Company has connected its Council Bluffs and Iowa lines with the Nebraska independent systems. Connection is made with the long-distance office of the independent companies in South Omaha, and through that switchboard with the Plattsmouth Telephone Company, the independent organization operating in the South Omaha commercial field. This arrangement will connect up about 100,000 independent telephones in Iowa and Nebraska. The towers carrying the 1,800 feet of aerial line across the river are substantial affairs, of steel construction, 120 feet high. Workmen have been engaged on them all summer. The Council Bluffs independent company's system now covers the western half of the state.

CARLYLE, ILL.—The telephone system in Clinton county is now being operated by the Citizens' Telephone and Telegraph Company, a company which was recently organized by citizens of Clinton county. The new company bought the system from George Johnpeter, of Posey, for $11,000, and it will continue to be operated in connection with the Central Union long-distance lines, although this county will be the exclusive territory of the home company for local business. The system will be extended to Shattuc, Boulder, St. Rose, Bartelso, Jamestown and other parts of the county. Another company, known as the People's Home Company, has applied to the county board for permission to build a system into the county. No action will be taken on the application until the December meeting.

ELECTRIC LIGHTING.

EATON, COL.—The Eaton Water, Light and Power Company's plant has been sold to W. J. Farr.

COOPERSTOWN, N. Y.—Charles H. Scofield has been granted a franchise by the Cherry Valley board of trustees to install an electric light plant in the town.

HOLTON, KAN.—The Holton electric light plant was destroyed by fire on October 2. The property was owned by a private company, and the city was negotiating for its purchase.

PITTSBURG, PA.—The new East End plant of the Duquesne Light Company has been placed in operation and is furnishing light to 1,000 families in the vicinity. The plant cost about $500,000.

NIAGARA FALLS, ONTARIO—The electric light committee of the city council has decided to go ahead with the proposed new construction work and the expenditure for the necessary material was authorized.

MILWAUKEE, WIS.—R. G. Hunt & Company, of Chicago, have been engaged by City Engineer Charles J. Poetsch as the city's experts to prepare plans for and supervise the construction of the municipal lighting plant.

MOREHEAD, KY.—The electric light plant, which suspended operation several months ago, has been purchased by Hiram Bradley and James E. Braden. The franchise was first granted to J. E. Davidson, who was compelled through financial reverses to dispose of it.

LANSING, MICH.—The Michigan Power Company, which is developing power from Grand river, in Lansing, and which has water rights at Diamondale, Grand Ledge and other points on the river, is making extensive improvement under the direction of its new superintendent, Thomas M. Keeley.

CATASAUQUA, PA.—The plant of the Lehigh-Northampton Gas and Electric Company, at Catasauqua, has been sold to Thomas F. Diefenderfer, attorney for a majority of the bondholders, for $100,500, as the result of a suit in equity brought by the People's Bank, of Wilkesbarre, trustee for the bondholders, which will reorganize the concern.

SUPERIOR, WIS.—The work on the Great Northern Power Company's plant is now so far along toward completion that the date for the turning on of the first 10,000 horse-power has been set as December 1. All of the electrical apparatus is on the grounds or has been shipped. The work of erecting the cables is progressing rapidly. After the turning on of the first 10,000 horse-power a month each is figured for the two additional installations of 10,000 horse-power.

NEWARK, N. J.—Without a dissenting vote the plans and specifications of Engineer James M. Seymour, Jr., of Newark, for the proposed municipal lighting plant to be operated by the city of Orange in conjunction with its water and sewerage pumps have been approved by the Orange common council, with the forms for contractors, and a resolution passed providing for advertising for bids for the work, contractors' estimates to be before the council and opened Monday night, October 29.

ALEXANDRIA, VA.—A decree has been entered in the United States District Court at Baltimore confirming the sale of the property of the Osage Manufacturing Company to the Alexandria Electric Light Company, and the deeds to the property ordered transferred to the new owners. The price paid was $19,500. The property has been in litigation for several years past, and although it was purchased by the electric company a few weeks ago, the work of installing the plant had to be postponed until the sale was confirmed by the courts. Edward E. Mandeville, of Philadelphia, to whom the franchise for supplying Alexandria with electricity was awarded by the city council and who organized the Alexandria Electric Company, has inspected the Osage property and has expressed himself as being pleased with it. There are several buildings located on the property which will be remodeled and used for the electric plant. The work of remodeling the buildings and installing the machinery will be commenced in the near future, and it is thought that the plant will be in operation by the end of the present year.

ELECTRIC RAILWAYS.

REDLANDS, CAL.—N. Buckmaster has applied for an electric railway franchise. Incorporated in the request is a clause providing for freight business.

GREENVILLE, TEX.—At a special meeting of the city council a franchise was granted to J. Mercer Carter, of Dallas, to build a street railway into the city.

OROVILLE, CAL.—The survey of a street railway system for Oroville has been completed by the Northern Electric Company and the chief engineer states that work will begin shortly.

RICHMOND, IND.—Ground has been broken for the excavation for the new power-house for the Indianapolis, New Castle & Toledo Traction Company, which will build a branch line to this city, at New Castle.

ST. LOUIS, MO.—Frank R. Tobin, a St. Louis capitalist, has been granted a franchise to build an interurban car line from El Paso to Ysleta, a distance of ten miles. He has also secured a concession from the El Paso electric line.

BOSTON, MASS.—The Washington avenue division car house of the Boston & Northern Street Railroad Company on Washington avenue, Chelsea, has been destroyed by fire. The house was filled with rolling stock and the total damage will reach $300,000, covered by insurance.

WALLA WALLA, WASH.—The Walla Walla Valley Traction Company, now building city and interurban electric lines here, announces that separate car service will be maintained to College Place, exclusive of the through line. The road is nearly completed to College Place.

PIERRE, S. D.—At a meeting in Onida, Sully county, to consider the question of assistance to an electric road across that county, township committees were appointed for every township to solicit for subscriptions to stock, the residents of that county being asked to take stock to the amount of $100,000.

CORINTH, MISS.—The Corinth & Shiloh Electric Railway Company has been financed and the bonds successfully floated by W. W. Williams & Company, Nashville, Tenn. The road is standard gauge and will carry freight and passengers, thus making cheap freight rates between St. Louis, Mo., and Corinth.

ROCK ISLAND, ILL.—The Moline, Rock Island & Eastern Traction Company held a business meeting in Rock Island and elected the following officers: president, J. F. Porter; vice-president, James F. Lardner; secretary, F. G. Young; treasurer, H. E. Casteel; attorney Burton F. Peek, Moline. The organization of the company ensures the construction of an interurban for the twin-cities in the near future.

PARIS, KY.—At a meeting of the promoters of the proposed electric line from North Middletown to Lexington, it was decided to raise $100,000 to guarantee the building of the road. Thirty thousand dollars of this amount is to be raised in Bourbon county. The proposed line will be about thirty-five miles in length, extending from Lexington to Sharpsburg, in Bath county, passing through the most populous section of Bourbon county from Clintonville to North Middletown.

SPOKANE, WASH.—Frank MacKean, of Chicago, announces that he has secured a contract to install a $2,000,000 power plant for the Spokane Western Power and Traction Company. It is expected to develop 2,000 horse-power which can be expanded to 40,000 horse-power. The company was incorporated in Washington, for $3,000,000 and Mr. MacKean announces that it is an entirely independent concern, backed by Chicago capitalists. The route of the proposed railway has not yet been determined.

RACINE, WIS.—The Milwaukee Light, Heat and Traction Company will not build its interurban line from Milwaukee to Lake Geneva through the city of Burlington, Racine county, unless the city grants a fifty-year franchise. The residents of the city are willing to give a twenty-five-year franchise, but protest against a longer term. John I. Beggs, of the Milwaukee company, has informed the city officials of Burlington that the road will be built near the outskirts of the city, unless a fifty-year franchise is granted.

DAVENPORT, IOWA.—The American Express company and the Iowa & Illinois Interurban have closed a deal whereby the Interurban will handle all the express company's business out of the tri-cities, transferring it to the Northwestern at Clinton. The contract is for five years and is the first express company contract made with an electric road in the country, so far as is known. This contract includes only the business to and from the tri-cities, the interurban continuing to handle the business of the intermediate towns.

NEGAUNEE, MICH.—On October 23 the properties of the Marquette County Gas Light and Traction Company, which for some time has been operated by a receiver, will be sold at public sale by order of the United States court. The company controls the trolley lines running between Negaunee and Ishpeming and operates gas and electric lighting plants. Its debts amount to about $300,000, including outstanding bonds, and it is expected that, even at a forced sale, the properties will realize more than enough to pay all indebtedness. It is said, however, that should the bids prove unsatisfactory, it is the purpose of Granger Farwell, of Chicago, holder of the bonds, to take over the plants himself, improve them extensively and put them upon a dividend-paying basis.

SPOKANE, WASH.—The Lewiston & Southeastern has under construction 115 miles of electric railway to connect Lewiston, Grangeville, Nez Perce and smaller towns in central Idaho and eastern Washington. The Spokane & Inland will connect Spokane, Waverly, Rosalia, Thornton, Colfax and Palouse early in October. This system covers 106 miles. A branch line from Spokane to Lake Pend d'Oreille, fifty-six miles, is expected to be in operation within a year. A company organized as the Spokane & Big Bend Electric Railway Company, of Spokane, W. H. Plummer, president, to build a road from Spokane to Davenport, 120 miles, has purchased ninety miles of right of way. Surveys have been completed, and the president announces that the road will be completed and in operation before June, 1907.

BALTIMORE, MD.—The Kent Traction Company, of Kent county at Chestertown, has been incorporated, a charter obtained and the enterprise successfully launched by Alva A. Lamkin, of this city. In speaking of the project, Mr. Lamkin said: "The undertaking as planned by the newly organized company will connect Chestertown, Tolchester, Rock Hall, Sandy Bottom, Georgetown and Fairlee, all in Kent county, by trolley. The money to be spent in building these lines will approximate $300,000, and the financial end is in such shape that work will be begun in about thirty days. The contract has been awarded to D. E. Baxter & Company, of New York, for the construction of the line between Tolchester and Chestertown, touching Fairlee and Georgetown. This portion of the line will cost about $200,000, and it is expected to have it in operation before Christmas. This line when completed will afford quick transportation between the Eastern Shore peninsula and Baltimore and will afford the farmers and truckers of Kent county a market for their perishable products the same day they are shipped. This line is expected to divert much of this traffic from Philadelphia to Baltimore. As it is a cross-country line, the mileage will be short, as will the time in making the run. Suitable freight cars will be operated by the company. The officers of the company are: Fred G. Usilton, president; Jefferson D. Bacchus, vice-president and treasurer, and Alva A. Lamkin, secretary and general manager. The directors will be made up of men from Kent and Queen Anne's counties and from Baltimore." It is proposed to issue five per cent mortgage bonds of $1,000 each. This issue will be for $200,000, and a part of it has already been placed.

EDUCATIONAL NOTE.

THE SILLIMAN LECTURES AT YALE UNIVERSITY—The Silliman lectures at Yale University will be delivered this year by Professor Walther Nernst, of the University of Berlin. There will be twelve lectures, delivered daily, the date for the first being October 22. The subject is a general consideration of the subject of thermodynamics and chemistry. The Silliman memorial lectures on subjects connected with the natural and moral world were established by the will of Augustus Ely Silliman, of Brooklyn, N. Y. The previous lecturers have been Professor J. J. Thomson, Professor Sherrington and Professor E. Rutherford.

PERSONAL MENTION.

MR. CARL E. CRAIG, who for the past year has been chief operator at the Nashua, N. H., exchange of the New England Telephone and Telegraph Company, has been appointed manager of the company's Laconia exchange.

MR. LOUIS H. FRICK, of Denver, Col., has been appointed general manager of the Cheyenne Light, Fuel and Power Company, which is owned by the Northern Colorado Power Company. Mr. Frick succeeds Mr. N. D. Miner, resigned.

MR. FRANK U. BLISS has resigned as general superintendent of the American Falls Power and Light Company, of Pocatello, Ida., and will probably move to Seattle, Wash., where he will undertake engineering work in the Puget Sound country.

MR. A. M. BARRON has resigned his position as manager of the Consolidated Light Company, of Joplin, Mo., and will move to Carterville, where he has purchased the Carterville Hotel. Mr. C. W. Huff, of Kansas City, will take Mr. Barron's place at Joplin.

MR. NORMAN MINER has become connected with the Bates Advertising Company, New York city, and will represent it in its central station advertising department. Mr. Miner has had considerable experience in this field, and is familiar with the laying out of advertising plans.

MR. EDWIN M. HAMLIN, Boston, Mass., announces his retirement from the Lord Electric Company. This company is about to move its manufacturing plant and headquarters to New York city, and Mr. Hamlin is unable to make this change because of other interests which are involved in New England.

MR. STANLEY GAINES has been appointed superintendent of the Wilson Electric Company, Huntingdon, Pa. The company furnishes light for the following towns: Huntingdon, Petersburg and Alexandria, Huntingdon county. Mr. Gaines resigns as superintendent of the Citizens' Electric Illuminating Company, of Wilkesbarre, Pa.

MR. C. F. BAKER has been engaged by Mr. L. B. Stillwell as superintendent of motive power and construction in connection with the engineering and operating contract which Mr. Stillwell has recently executed with the United Railways and Electric Company, of Baltimore. Mr. Baker is well known to the engineering fraternity and to the street railway world. For many years he was with the West End Street Railway Company, of Boston, and with the Boston Elevated Railway Company in charge of construction and operation of power plants and rolling stock. He is a past-president of the American Street Railway Mechanical and Electrical Association, and also of the New England Steam Railroad Club, and is an active member of the New England Street Railway Club.

MR. JAMES H. BARRY, superintendent of the central division of the New England Telephone and Telegraph Company, with headquarters at Lowell, Mass., has been promoted to the post of division superintendent, with headquarters at Boston. The headquarters of the central division has been moved from Lowell to Boston, the work of this division having been apportioned among five division superintendents, who will report to Mr. Barry at Boston. Mr. Barry entered the service of the company twenty years ago. In 1896 he was appointed superintendent of the northern division, in charge of the state of Vermont. A year later he was transferred to the western division, with headquarters at Springfield, and in 1898 he went to Lowell as superintendent of the central division.

OBITUARY NOTE.

MR. JOHN E. POWELL, president of the Pittsburg (Pa.) Light and Manufacturing Company, and treasurer of the National Cable and Wire Company, Pittsburg, Pa., died at West Middlesex, Mercer county, Pa., on October 6. Mr. Powell was forty years of age, and was elected a member of the Pennsylvania state legislature in 1902.

NEW MANUFACTURING COMPANY.

SPRINGFIELD, ILL.—The Freeman-Sweet Company, of Chicago, has been incorporated to deal in electrical apparatus. The incorporators are: Ernest Freeman, Frank Z. Sweet and J. G. Spurling. The capital of the company is $25,000.

ELECTRICAL SECURITIES.

There was considerable improvement in the tone of the market during the week. The course of prices, while irregular, was generally upward, and there were a number of rallies as compared with the previous week. Dealings, however, were mainly professional, the speculative public evincing small interest. It is not believed that an active campaign will be inaugurated for some little time, probably not until after the November election. One of the main factors in the market's improvement has been the easing monetary situation. While local sentiment was adversely influenced by an increase of over $13,000,000 in loans shown in the bank statement, this was offset by the showing made by the banks of an increase of over $8,000,000 in cash and over $3,000,000 in surplus reserve. A favorable influence was also exerted by the government wheat crop report, which shows a new high record of 2,780,069,000 bushels, as against a previous high record of 2,707,993,000 bushels. A number of railroads issued their annual reports. These indicate the present great prosperity of the transportation industry, showing large increases in both gross and net earnings in all cases.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 13.

New York:	*Closing.*
Allis-Chalmers common	17¼
Allis-Chalmers preferred	45
Brooklyn Rapid Transit	78⅛
Consolidated Gas	142
General Electric	179½
Interborough-Metropolitan common	37½
Interborough-Metropolitan preferred	77
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	72
Mackay Companies (Postal Telegraph and Cables) preferred	70½
Manhattan Elevated	146
Metropolitan Street Railway	106
New York & New Jersey Telephone	125
Western Union	86⅛
Westinghouse Manufacturing Company	156
Boston:	*Closing.*
American Telephone and Telegraph	136
Edison Electric Illuminating	235
Massachusetts Electric	71
New England Telephone	130
Western Telephone and Telegraph preferred	85

The annual report of the Edison Electric Illuminating Company of Boston for the fiscal year ended June 30 last shows an increase in gross and net earnings, while the surplus more than doubled during the twelve months. There was no change in the capital stock of the company in the year, and, although the natural growth was great, all the money necessary for construction was raised by temporary notes. It is expected that in the present fiscal year the stockholders may be called together again to authorize a petition to the Massachusetts board of gas and electric light commissioners for permission to add to the present capital of $11,500,000. Lamps and motors connected on June 30 last are as follows: incandescent lamps 788,560, arc lamps 10,534, motors (horse-power) 30,432. Leaving out of consideration the new business acquired in the purchase of the property of other companies, the regular increase in the current year is greater than in any previous year in the history of the company. Since the close of the last fiscal year a new price list has been put into effect, which favorably affects more than 14,000 of the customers of the company. Although this will materially cut down the income from existing customers, it is confidently expected that it will be more than made up by the new business that will be the natural result.

Philadelphia:	*Closing.*
Electric Company of America	11⅞
Electric Storage Battery common	72
Electric Storage Battery preferred	72
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	28⅜
United Gas Improvement	89¾
Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	140½
Metropolitan Elevated preferred	66½
National Carbon common	84
National Carbon preferred	118
Union Traction common	4½
Union Traction preferred	16½

NEW INCORPORATIONS.

SPRINGFIELD, ILL.—Home Telephone Company, St. Jacobs. $5,000.

SPRINGFIELD, ILL.—Green River Telephone Company, Harmon. $2,000. Incorporators: Elmer Cotton, C. F. Ribordy and G. F. Brooks.

WEBSTER CITY, IOWA—Martin Telephone Company. To do a general telephone business and to establish telegraph and electric light lines. $200,000.

MONTGOMERY, ALA.—Thomasville Manufacturing, Electric Light and Power Company. $11,000. Incorporators: W. A. Scott, Jr., John S. Henson and others.

COLUMBUS, OHIO—The Muskingum River Traction Company, of Marietta. To construct a street railway connecting Marietta and Beverly. $25,000. Incorporators: C. H. Shattuck, W. W. Mills, A. D. Follett, C. C. Tospy and W. H. H. Jett.

CHARLESTON, S. C.—St. Andrew Railway Company. To construct a line from Charleston through St. Andrew's parish to Meggett, for the purpose of facilitating the movement of freight. $5,000, with the privilege of increasing to $1,000,000.

INDIANAPOLIS, IND.—The Winona & Maxinkuckee Railway Company, of South Bend. To build an electric road between Culver, Warsaw and Argos. $10,000. Directors: Edwin P. Taylor, S. I. Perley, Alexis Coquillard, Virginius Miar and T. P. Moredock.

FRESNO, CAL.—Merchants' Independent Electric Company. $200,000. Directors: Fred Dodd, Fresno; Arthur Gore, Los Angeles; W. J. Eilert, Fresno; H. A. Sprague, Fresno; R. J. Woodward, Fresno; J. J. Graves, Fresno; J. B. Lankershim, Los Angeles.

ALBANY, N. Y.—Otselic Valley Railroad Company, South Otselic. To operate an electric or gasolene railroad, twelve miles long, from South Otselic to Georgetown Station, Madison county. $220,000. Directors: B. F. Gladding, E. C. Stack and M. K. Perkins, South Otselic.

COLUMBUS, OHIO—The Ohio & Southern Traction Company, Columbus. To construct an electric road from the south corporation line of Columbus to the farm of S. B. Hartman, four and one-half miles south, over the Columbus and Chillicothe pike. $75,000. Incorporators: S. B. Hartman, F. W. Schumacher, James M. Butler, W. V. Baker and J. A. Hedges.

AUSTIN, TEX.—Texas Traction Company, of Dallas. To construct or acquire an electric line of railway from Dallas to Sherman and to own and operate street railways in those two cities. $3,000,000. Incorporators: Frank H. Proctor, Boston; Walter C. Clark, W. R. Brents, Grayson county; J. S. Heard, Collin county; R. H. Baker, Travis county; W. J. Neale, McLennon county; Fred A. Jones, Harris county; M. B. Templeton, Ellis county; D. A. Templeton, Oscar Goodwin, J. F. Strickland, John N. Simpson, Dallas.

AUGUSTA, ME.—York & Oxford Railway Company. To construct a standard gauge railroad, to be operated by electricity, compressed air or animal power, from the terminus of the Atlantic Shore Line Railway, in the village of Springvale through the towns of Sanford, Shapleigh, Acton, Newfield, Limerick, Parsonfield and Cornish in York county; Porter and Hiram in Oxford county, and from Baldwin to Bridgton Junction in Cumberland county, a total mileage of forty miles. $160,000. Directors: Fred J. Allen, George W. Hanson, Sanford; J. M. Lord, Parsonsfield; Henry E. Eastman, Charles G. Moulton, Limerick; Ira H. Moore, A. P. Towle, Newfield.

ALBANY, N. Y.—The Honk Falls Electric Company, Napanoch, Ulster county. To operate in the towns of Wawarsing, Rochester, Marbletown, Hurley, Ulster, Rosendale, New Paltz, Gardiner and Shawangunk, and the villages of Ellenville, Rosendale and New Paltz and the city of Kingston, Ulster county; in the towns of Crawford, Montgomery, Newburgh and Wallkill, and the villages of Montgomery, Walden and the cities of Middletown and Newburgh, Orange county, the towns of Thompson, Liberty, Fallsburg and Mamakating, and the villages of Monticello, Liberty and Wurtsboro, Sullivan county. $15,000. Directors: Susan C. Dickinson and Milton L. Dickinson, of Fitchburg, Mass., and Thomas Gray, of Ellenville.

INDUSTRIAL ITEMS.

JOSEPH P. DEVINE, Buffalo, N. Y., has ready for distribution a new catalogue describing and illustrating the vacuum drying and impregnating apparatus manufactured under the Passburg patents.

THE ADVANCE ELECTRIC COMPANY, St. Louis, Mo., will be pleased to send a leaflet describing its alternating-current motors. These are single-phase motors of the brush and commutator class.

THE HOLOPHANE GLASS COMPANY, New York city, announces that its sales have so increased that it has been necessary to more than double the size of the stock room and stock. An enlargement has also been made in the company's demonstration rooms.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has ready for distribution a new catalogue describing and giving prices of "Noark" enclosed fuse devices, National Electrical Code standard. This catalogue will be sent to any one interested upon request.

THE SCHMIDT-WILCKES ELECTRIC COMPANY, 135 William street, New York city, has ready for distribution a new catalogue describing its intercommunicating and private line telephone system. This booklet shows an entirely new line of instruments devised and invented by Lambert Schmidt.

THE LORD ELECTRIC COMPANY, Boston, Mass., announces the removal of its manufacturing plant and headquarters to New York city, where it will have improved facilities for handling its rapidly increasing business. The Boston office will be continued as a branch department. After November 1 the New York headquarters will be at the Fuller Building.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., has ready for distribution price list No. 7, applying to catalogue No. 12, dealing with electric light supplies. Particular attention is called to the changes in prices of entrance-switch boxes, taplets, panel cutouts for rotary switches and cartridge fuse cutouts. This price list will be sent to any one interested upon request.

HARVEY HUBBELL, INCORPORATED, Bridgeport, Ct., is publishing a small catalogue devoted to the Hubbell shade-holder, shade and guard. A unique feature of this catalogue is an illustration showing "the one collar that fits them all." This collar may be used with the regular shade-holder, shade-holder with locking spring, half reflector, enameled steel shade, cone shade, flat shade, parabolic shade and lamp guard.

I. P. FRINK, 551 Pearl street, New York city, designer and manufacturer of the Frink system of reflectors, announces the equipment of the Essex County Court House, Newark, N. J.; the Hall of Records, Brooklyn, N. Y., and the Hall of Records, New York city, with reflectors for unusual conditions. This system has become a recognized solution of many difficult illuminating problems, a careful analysis of which is now engaging the attention of the most prominent architects and engineers.

THE HEANY FIREPROOF WIRE COMPANY, York, Pa., has published an interesting and instructive pamphlet entitled "Cotton *versus* Fireproof Insulation." The insulation manufactured by this company is a white asbestos composition, and is inorganic and chemically neutral. The company is distributing a hanger, upon which are mounted three samples of fireproof insulated magnet wire. It is stated that coils wound with this wire will not be destroyed, even though the wire becomes red hot.

THE H. A. PETERSEN MANUFACTURING COMPANY, Harvey, Ill., is the subject of an extensive article in the Harvey *Herald* of Friday, September 28. This company has recently opened a new factory at Harvey, 75 by 125 feet, located directly on the Chicago Terminal Transfer Belt Line Railway and the Grand Trunk Railway, and has the service of 400 feet of switch track on its grounds. The company manufactures architectural iron work and a complete line of "Harvey-Duct" electrical conduits and fittings.

CROSBY, CRAFT & COMPANY, Cleveland, Ohio, have removed their offices from the Citizens' Building to 723 Williamson Building. This company is the agent in northern Ohio for the Switchboard Equipment Company, the Whitney Electrical Instrument Company, the Northwestern Manufacturing Company, the Fort Wayne Electric Works and the General Storage Battery Company. The com-

pany reports that it has closed a contract with the Brown Hoisting Machinery Company, Cleveland, Ohio, for sixty-nine large-capacity circuit-breakers made by the Switchboard Equipment Company. The Brown Hoisting Machinery Company will use these circuit-breakers in connection with an installation which is being furnished for the Carnegie Steel Company.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has ready for distribution a new series of advertising literature. This includes flier No. 3488, giving information on packing and standard package quantities; bulletin No. 4457, describing parts of form B arc headlights; No. 4459, feeder regulators; No. 4460, parts of form 3 luminous constant-current series enclosed arc lamps with stationary upper electrodes; No. 4461 GE-78 railway motor; No. 4462, variable-speed, direct-current motors with commutating poles; No. 4463, carrier bus arc panels for Brush arc generators, and No. 4464, polyphase induction motors. Price list No. 5154 gives quotations on tantalum lamps and tantalum units. There is also a supply catalogue, No. 7602, giving quotations and complete information on parts of direct-current, automatic circuit-breakers, and a handsome catalogue devoted to type H transformers.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is being awarded an increased number of government contracts. A contract recently closed calls for a large amount of electrical power-generating apparatus, to be installed in the Navy Yard at Norfolk, Va. The contract totals $91,125, and consists of the following apparatus: two 1,000-kilowatt, three-phase, 2,200-volt, 7,200-alternation, 1,800-revolution-per-minute steam-turbine generating units; one 500-kilowatt, three-phase, 2,200-volt, 7,200-alternation, 3,600-revolution-per-minute steam-turbine generating unit; two fifty-kilowatt steam-driven exciter units; five fifty-kilowatt motor-generator sets. The motors comprising these sets are of the CCL type, three-phase, 2,200-volt, 7,200-alternation, 1,120-revolutions-per-minute. The direct-current generators are 95-140-volt machines. An interesting part of the equipment is the switchboard, which will have forty-two panels. A large amount of auxiliary apparatus is included in the contract.

THE YALE & TOWNE MANUFACTURING COMPANY, New York city, is doing some very active advertising of a nature particularly designed to assist the dealer in marketing his goods. In addition to a number of very nicely executed fliers calling attention to various forms of Yale padlocks, there is a booklet entitled "A Book about Padlocks." This enumerates a large number of opportunities for the use of these padlocks, each suggestion being illustrated by some characteristic line drawing. Then there is another booklet, got up in unique form, entitled "The Little Black Box." This is a little story which introduces the utility of the Yale padlock. There is a more ambitious booklet entitled "Suggestions for Selling Yale Padlocks." This booklet outlines the advertising campaign which the company has inaugurated, and is replete with suggestions of a timely and helpful nature. On all the literature which the company supplies to the dealer, space is left in a proper place for the imprinting of the dealer's name and local address.

THE STANDARD ROLLER BEARING COMPANY, Philadelphia, Pa., has purchased the entire plant and real estate of the Pennsylvania Iron Works Company, which adjoins its present property. By this purchase the Standard Roller Bearing Company has secured five factory buildings with a total of over 110,000 square feet of floor space, with real estate 1,600 by 120 feet, all located on the main line of the Pennsylvania Railroad. The total length of the property which the Standard Roller Bearing Company will now occupy is over half a mile, with an average width of 200 feet, covering 500,000 square feet of floor space. The cash paid for the above property was nearly $250,000, and it will be immediately equipped with a full line of machinery at an expense of over $200,000. In addition to this purchase the company is at present erecting a large reenforced concrete building in the vicinity of Philadelphia, five stories high, 100 by 210 feet in ground area. This building will be devoted exclusively to the manufacture of annular ball bearings, automobile axles and the like. Over 1,200 hands are now employed, and as soon as the concrete building is in full operation, which will be in about thirty days, over 1,800 will be employed. When alterations are completed on the Pennsylvania Iron Works property over 3,000 employés will be at work. During the past few months the company has built and equipped a large crucible steel-casting plant, as well as an iron and brass foundry. The company has also completed a drop forge plant, 100 by 150 feet, fully equipped with Billings & Spencer drop hammers, where all the drop forgings used in automobile axles and similar products will be made.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces a large number of orders by some of the largest manufacturers in the United States. The majority of the apparatus is to be installed where the company's machines have been tested under actual operation. The following list gives an idea of the very general distribution of the Crocker-Wheeler Company's material: Gilbert Knitting Company, one 300-kilowatt alternating-current generator, 240 volts, 257 revolutions per minute, and one thirteen-kilowatt direct-current generator, 125 volts, 900 revolutions per minute as exciter. Eastman Kodak Company, Rochester, N. Y., one 300-kilowatt direct-current generator, for twenty-five volts, 100 revolutions per minute. Chicago, Indiana & Southern Railway Company, two 100-kilowatt alternating-current generators, 240 volts, 257 revolutions per minute; two six-and-one-half-kilowatt direct-current generators, 125 volts, 1,150 revolutions per minute as exciters. American Smelting and Refining Company, Pueblo plant, Pueblo, Col., one twenty-horse-power direct-current motor, 500 volts, 820 revolutions per minute; one forty-five-horse-power direct-current motor, 500 volts, 1,000 revolutions per minute. Arkansas Valley Plant, Leadville, Col., one forty-five-horse-power direct-current motor, 220 volts, 925 revolutions per minute. Eilers Plant, Pueblo, Col., one forty-five-horse-power, direct-current motor, 230 volts, 925 revolutions per minute. Globe Plant, Denver, Col., two twenty-horse-power direct-current motors, 500 volts, 820 revolutions per minute; one forty-five-horse-power direct-current motor, 500 volts, 1,000 revolutions per minute. Orford Copper Company, Bayonne, N. J., four 300-kilowatt direct-current generators, 125 volts, 150 revolutions per minute. Strouse, Adler & Company, New Haven, Ct., one 100-kilowatt direct-current generator, 250 volts, and seventeen direct-current motors, ranging from one to five horse-power, all of 230 volts. Becker Brothers, Chicago, Ill., 100 one-and-one-quarter-horse-power form L motors for driving bottle-washing machinery. Manufacturers' Contracting Company, Wilmington, Del., one 100-kilowatt direct-current generator, 125 volts, and one seventy-five-kilowatt direct-current, 125-volt generator. Borough of Kutztown, Kutztown, Pa., one seventy-five-kilowatt alternating-current generator, 2,300 volts, 900 revolutions per minute.

Record of Electrical Patents.

Week of October 9.

832,600. SPEED-INDICATOR. Hans Dahl, Berlin, Germany. Filed February 14, 1902. Centrifugally operated contacts indicate successive speeds.

832,610. PERMANENTLY PLIABLE AND ADHESIVE COMPOUND FOR INSULATING AND OTHER PURPOSES. Robert L. Johnstone, Glen Ridge, N. J. Filed May 14, 1903. Renewed March 9, 1906. A compound consisting of gutta-percha, resin and carnauba wax.

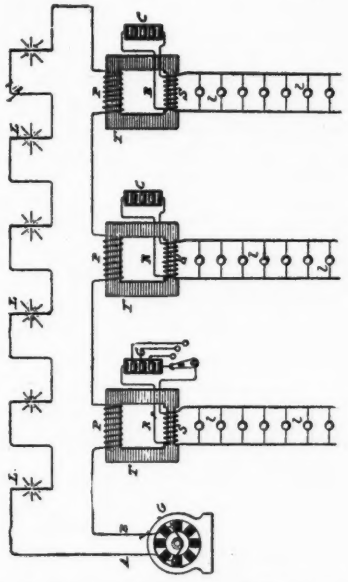
832,612. METHOD OF INSTALLING ELECTRIC OUTLETS AND FIRE-PROOF WALLS AND PARTITIONS CONTAINING THE SAME. Louis Kalischer, Brooklyn, N. Y. Filed September 25, 1903. A supporting arm provides a plurality of outlets, around which the wall is built.

832,622. OPERATION OF SHIPS' PROPELLERS. Cesidio Del Proposto, Nicolaieff, Russia. Filed November 27, 1903. A dynamo and motor are coupled to the shaft of a non-reversible engine.

832,632. MULTIPLE CONTACT FOR ELECTRICAL CONDENSERS. John F. Skirrow, East Orange, N. J. Filed March 14, 1905. A block of insulating material contains contact fingers in parallel grooves.

832,642. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. Utilizes a vertically rotated laminated separator placed between magnetic poles.

832,652. RAILWAY BLOCK-SIGNAL SYSTEM. Abram L. Bower, Boyertown, Pa. Filed October 22, 1902. Actuates signals in the locomotive cab.



832,852. SYSTEM OF DISTRIBUTING ELECTRICITY BY ALTERNATING CURRENTS.

832,653. ELECTRICALLY DRIVEN FLUID MOTOR. Gaston A. Bronder, Brooklyn, N. Y. Filed February 12, 1903. A motor-driven compressor supplies the actuating fluid.

832,705. CIRCUIT-BREAKER. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to General Electric Company. Filed March 20, 1905. Two contacts are used which engage and disengage in sequence.

832,709. APPARATUS FOR INSURING SAFETY OF TRAFFIC ON SINGLE LINES OF RAILWAY. Edward Tyer, Dalston, England, and James H. Hamilton, Cape Town, Cape Colony. Filed January 5, 1904. Two magnets placed at right angles make possible the step-by-step rotation of this signal.

832,712. TROLLEY. Henry West, Galesburg, Ill. Filed July 20, 1903. A collector ring and contacts are provided within the wheel.

832,713. ALTERNATING-CURRENT MOTOR. John B. Wiard, Lynn, Mass., assignor to General Electric Company. Filed February 23, 1904. Two separate windings are provided for starting and for running.

832,718. ELECTRIC RECEPTACLE. Charles A. Chase, Chicago, Ill. Filed April 29, 1905. A method of construction.

832,720. LIQUID RHEOSTAT. George W. Cravens, Schenectady, N. Y., assignor to General Electric Company. Filed October 21, 1905. Consists of a plurality of conducting elements and a common neutral, and means for varying each of the former independently.

832,724. ALTERNATING-CURRENT MOTOR. Friedrich Eichberg, Berlin, Germany, assignor to General Electric Company. Filed January 12, 1905. A motor of the commutator type having two windings.

832,729. AUTOMATIC UNLOCKING DEVICE FOR SWITCH MECHANISMS. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to General Electric Company. Filed April 20, 1904. Is operated by an electromagnet controlled by alternating currents.

832,730. INCANDESCENT ELECTRIC LAMP. Harry C. Hubbell, Jersey City, N. J. Filed January 26, 1905. A filament supported so that it falls when broken.

832,741. REPULSION-MOTOR CONTROL. Maurice Milch, Schenectady, N. Y., assignor to General Electric Company. Filed April 30, 1904. Renewed February 9, 1906. A method of impressing a variable electromotive force on the secondary of a motor of the repulsion type.

832,742. UNIPOLAR ALTERNATING-CURRENT MACHINE. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. Filed March 17, 1905. The field is excited by an alternating current.

832,745. MOTOR CONTROL. Jesse S. Pevear, Schenectady, N. Y., assignor to General Electric Company. Filed August 10, 1904. A system of controlling motors of the alternating-direct-current type.

832,746. TELEPHONE CIRCUIT. Milton W. Phillips, Ventura, Cal. Filed February 20, 1906. A locking-out party line system.

832,747. ELECTRIC CLOCK-WINDING MECHANISM. George H. Rupley, Schenectady, N. Y. Filed July 14, 1905. The spring is automatically wound by a motor.

832,761. ELECTRIC TIME SWITCH. Charles H. Van Slyck, Philadelphia, Pa., assignor to General Electric Company. Filed October 9, 1899. The main switch is opened by a magnet, itself controlled by a clock mechanism.

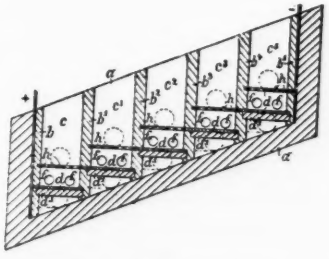
832,765. TROLLEY WHEEL AND SUPPORT. Big G. Young and Charles N. Pickering, Cedar Grove, W. Va. Filed November 13, 1905. A trolley of the swiveling type.

832,767. ELECTRICALLY TREATING AIR OR OTHER GASES. James H. Bridge, Philadelphia, Pa. Filed April 3, 1906. Gas is passed between charged plates, one of which is perforated.

832,768. ELECTRIFIER FOR TREATING AIR OR OTHER GAS. James H. Bridge, Philadelphia, Pa. Filed May 25, 1906. A method of constructing electrodes for the preceding patent.

832,809. MACHINE FOR MAKING BATTERY GRIDS. Willard F. Richards, Buffalo, N. Y., assignor to Gould Coupler Company, New York, N. Y. Filed May 25, 1904. A grid-spinning machine.

832,820. MAGNETIC SEPARATOR. Frederick T. Snyder, Oak Park, Ill., assignor, by mesne assignments, to International Separator Company, Chicago, Ill. Filed December 20, 1902. Renewed June 9, 1906. The magnet, alternately excited and neutral, separates the materials as they move with a reciprocating motion past it.



832,983. ELECTRODE FOR USE IN THE MANUFACTURE OF BLEACHING LIQUOR.

832,821. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, and Frederick T. Snyder, Oak Park, Ill., assignors to International Separator Company, Chicago, Ill. Filed March 9, 1905. A rotating magnetic cylinder is placed diagonally over a separating table.

832,822. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, and Frederick T. Snyder, Oak Park, Ill. Filed March 9, 1905. A horizontally toothed armature rotates in a horizontal field.

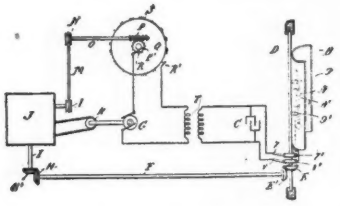
832,823. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. The materials to be separated are conducted by a fluid through the magnetic field.

832,824. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. A laminated annular pole-piece rotates between fixed pole-pieces.

832,825. MAGNETIC SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. A concentrically laminated annular armature rotates over an annular table.

832,826. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago., Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. A revolving tapered magnet rotates in proximity to a tapered fixed magnet.

832,827. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago., Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. Both rotating armature and fixed poles are covered with non-magnetic shields.



833,034. AEROPHORE.

832,828. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago., Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. A fixed pole opposing a rotating armature which is shaped to concentrate the magnetic field.

832,829. MAGNETIC SEPARATOR. Henry H., Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed April 24, 1905. A magnetic attracting surface provided with pyramidal projections.

832,847. LOCK FOR SIGNALS. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed February 7, 1906. A magnetically controlled locking device.

832,849. ELECTRIC PERFORATING MACHINE. George H. Davis, Brooklyn, N. Y. Filed April 22, 1901. An electrically operated punch-controlling device.

832,852. SYSTEM OF DISTRIBUTING ELECTRICITY BY ALTERNATING CURRENTS. William M. Fairfax, Brooklyn, N. Y. Filed July 18, 1892. A series system provided with means for maintaining constant potential on secondary circuits.

832,862. MEANS FOR INSTALLING ELECTRIC OUTLETS. Louis Kalischer, Brooklyn, N. Y. Filed October 1, 1903. A device for supporting outlets.

832,876. CONNECTOR FOR TELEPHONE AND OTHER WIRES. Charles L. Peirce, Jr., Chicago, Ill., assignor to Peirce Specialty Company, Chicago, Ill. Filed May 31, 1905. The wires are clamped against an interposed conducting plate.

832,880. ART OF PRECIPITATING METALS FROM CYANID SOLUTIONS. William J. Sharwood, Berkeley, Cal., assignor of one-half to Charles W. Merrill, Lead, S. D. Filed February 24, 1904. The solution is brought into contact with a finely divided, more electropositive metal.

832,912. RHEOSTAT. Fred R. Kunkel, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 12, 1905. A rheostat for placing in the hollow base of small motors.

832,913. FAN-MOTOR ADAPTER. Fred R. Kunkel, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed August 2, 1905. A slotted hollow elbow.

832,926. MULTIPLE-UNIT SWITCH-CONTROL SYSTEM. Francis H. Shepard, New York, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Filed February 12, 1904. The patent covers the sequence of steps followed in cutting out the starting resistance.

832,934. ELECTRIC GLOW LAMP. John Van Vleck, New York, N. Y., assignor, by mesne assignments, to Nernst Lamp Company, Pittsburg, Pa. Filed May 9, 1899. A lamp of the Nernst type.

832,946. AUTOMATIC RELEASE FOR PARTY-LINE EXCHANGES. Clarence A. Anderson, Salina, and William Hagstrom, Lindsborg, Kan., assignors of one-third to John Anderson, Salina, Kan. Filed February 8, 1905. A prolonged releasing impulse is sent automatically over the line.

832,951. SUSPENSORY DEVICE FOR ELECTRIC LAMPS. Samuel R. Bell, Tuscaloosa, Ala. Filed September 19, 1905. A spring-controlled adjustable suspension.

832,963. INDICATOR. Harrison D. Flegel, Racine, Wis., assignor, by direct and mesne assignments, to Daniel L. Hayward, Chicago Heights, Ill. Filed April 20, 1905. A step-by-step movement is secured through a magnetically actuated rocker-arm.

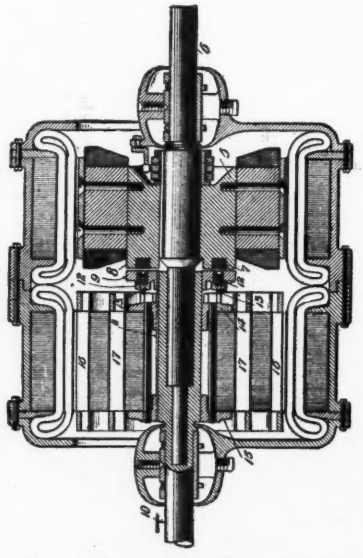
832,983. ELECTRODE FOR USE IN THE MANUFACTURE OF BLEACHING LIQUOR. Richard Kother, Cunewalde, Germany, assignor of one-half to Charles Edward Waithman, Gaddum, Montford, Cheshire, England. Filed November 3, 1905. A step-like arrangement of electrodes in similarly placed cells, whereby one plate acts both as anode and cathode.

833,009. CORD-ADJUSTER. George B. Smith, Indianola, Neb. Filed April 28, 1906. A cord-adjuster of looped wire.

833,017. ELECTRIC RAILWAY. Miles E. Bailey, Washington, D. C. Filed May 27, 1905. A siding normally insulated from the main line, provided with means for connecting it to the latter.

833,034. AEROPHORE. Lee de Forest, New York, N. Y. Filed December 8, 1905. A system for directing electromagnetic wave-signals.

833,051. ELECTROMECHANICAL TRANSMISSION DEVICE. Arthur W. Harrison, Los Angeles, Cal. Filed June 12, 1905. A combined motor and generator with independent shafts which may be coupled magnetically.



833,051. ELECTROMECHANICAL TRANSMISSION DEVICE.

833,080. TROLLEY. Elijah D. McDonald, Los Angeles, Cal. Original application filed August 31, 1905. Divided and this application filed November 28, 1905. A method of construction.

833,125. ELECTRIC SYSTEM FOR OPERATING BULKHEAD DOORS, HATCHES, ETC. William B. Cowles, Cleveland, Ohio, assignor to the "Long Arm" System Company, Cleveland, Ohio. Filed July 11, 1904. A safety spring is interposed in the gear train.

833,135. HIGH-TENSION TERMINAL FOR SPARK-COILS. Edward B. Jacobson, Pittsfield, Mass., assignor to Pittsfield Spark-Coil Company, Pittsfield, Mass. Filed February 7, 1906. A method of construction.